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COMPARATIVE MORPHOLOGY OF THE FOLIAR SCLEREIDS IN THE GENUS MOURIRIA AUBL.

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With eleven plates

INTRODUCTION

A RECENT intensive study of the foliar sclereids of *Trochodendron aralioides* revealed the remarkable fluctuation in the form and structure of such cells which occur within a single species (10). Because of this polymorphism, one might question the diagnostic value of foliar sclereids in the distinction of species, genera, and tribes within the angiosperms, despite the extensive literature which has accumulated on this subject (cf. the resumé in Solereder, 20). Upon careful examination, much of the early systematic work on foliar sclereids seems inadequate for two reasons. First of all, in many cases the morphological observations are not correlated with specific herbarium collections. Secondly, very little attention is paid to the possibility of variation in sclereid-type between different leaves of one individual and between leaves of different individuals of the same species. As a result, it is hazardous or indeed impossible in many instances to generalize with respect to the major trends in morphological specialization of foliar sclereids within systematic units. Further evidence of the present uncertainty of our knowledge is provided by the investigations of Bailey and Nast (5) on the variable trends of specialization in the foliar sclerenchyma of the species and genera in the Winteraceae.

It is evident, therefore, that intensive and rigorously documented studies on the foliar sclereids of a wide series of genera are highly desirable. In the present article the results of a comparative study of the foliar sclereids of *Mouriria* Aubl. (Melastomataceae) are presented. This genus, according to van Tieghem (21), exhibits a wide range of sclereid-types, each of which is illustrated by a series of species. Moreover, the consistent presence of foliar sclereids in *Mouriria* as well as in the presumably closely related genus *Memecylon* L. was utilized by van Tieghem as the

basis for segregating these genera in the subtribe "Mouririées" under the family "Mélastomacées." Unfortunately, however, van Tieghem included neither the author-names of the species of *Mouriria* studied nor citations to specific herbarium specimens. Consequently in the present study a complete re-examination of the foliar sclereids of *Mouriria* has been made, utilizing an extensive series of herbarium collections.

In Cogniaux's (7) monographic treatment of *Mouriria*, 40 species and one "species non satis nota" are recognized. Since the publication of his work many new entities have been described, so that the genus now contains approximately 80 species. The present survey is based upon the examination of 69 species and includes material representing all but 6 of the entities included by Cogniaux as well as all the species discussed by Hoehne (12) and Ducke (8). While it is recognized that some of the entities used may subsequently prove to have been incorrectly determined, the morphological descriptions are based on cited specimens and are thus subject to verification. Furthermore, in the majority of species examined, two or more separate collections were available, thereby permitting some study at least of morphological variations. In the case of 17 species, leaves from the type collection were investigated. Although the importance of type material should not be over-rated in a study of this sort, morphological data on such specimens will need to be considered in any future revision of the genus.

Grateful acknowledgement is made to my wife, Helen Vincent Foster, for her drawings of the sclereids illustrated in *Plate XI*. The writer also thanks Professor I. W. Bailey and Dr. A. C. Smith for many helpful comments during the progress of the investigation.

MATERIALS

The herbarium leaf-specimens forming the material for this investigation were secured through the generous coöperation of the following individuals: Dr. A. C. Smith, of the Arnold Arboretum (A); Dr. Paul C. Standley, of the Chicago Natural History Museum (Ch); Dr. J. M. Greenman, of the Missouri Botanical Garden (M); Dr. H. A. Gleason, of the New York Botanical Garden (NY); Dr. E. P. Killip, of the U.S. National Herbarium (US); Dr. Lyman B. Smith, of the Gray Herbarium (GH); Dr. H. L. Mason, of the University of California (UC); Dr. C. L. Wilson, of Dartmouth College (Dart); and Dr. J. T. Roig, of the Estación Experimental, Santiago de las Vegas, Cuba (Cu). Through the kindness of Dr. F. C. Hoehne of the Institute de Botanica at São Paulo and Dr. J. G. Kuhlmann of the Jardim Botanico at Rio de Janeiro, a separate collection of leaf-specimens of 30 species of *Mouriria* has also been investigated. This material is derived from specimens deposited in the herbarium of the Jardim Botanico (HJBR). The writer is also indebted to the authorities of the Instituto Agronômico do Norte, Belem, Pará, Brazil, for dried and preserved leaves of *M. crassifolia* Sagot. This valuable material

was collected "in virgin forest 8 km. from Manaus" by J. P. Murça and was determined by Dr. A. Ducke.

For convenience in reference, the species used in the present study have been arranged below in alphabetical order. At the end of this list are appended a number of undetermined specimens. In all cases, the symbol in parentheses following the citation of each specimen designates one of the herbaria listed above. An asterisk preceding a species name indicates that material from the type collection has been studied.

M. abnormis Naud. FRENCH GUIANA: *Mélinon* in 1861 (Ch).

**M. acuta* Griseb. CUBA: *Wright 2469* (M, TYPE COLL.); *Jack 7955* (Ch); *Britton, Britton & Cowell 9730* (NY, US); *Jack 5741* (A); *Ekman 16384* (US).

M. acutiflora Naud. BRAZIL: *Ule 7677* (UC); *Kuhlman 4546* (HJBR); *Ducke 18497* (HJBR); HJBR, Rio Madeira, Amazonas; *Krukoff 26653* (HJBR); *Ducke 18500* (HJBR). BRITISH GUIANA: *A. C. Smith 2573* (A); *A. S. Pinkus 195* (US).

**M. acutiflora* var. *oligantha* Gleason. SURINAM: *B. W. 6286* (US, TYPE COLL.).

**M. angustifolia* Spruce. BRAZIL: *Spruce 2987* (GH, TYPE COLL.).

M. anomala Pulle. BRAZIL: *Ducke 14373* (HJBR, US); *Ducke 105* (Ch); *Ducke 25515* (HJBR).

M. Apiranga Spruce. BRAZIL: *da Costa 124* (Ch); *Ducke 18495* (HJBR); *Ducke 35736* (HJBR). PERU: *Ule 9678* (US).

**M. arborea* Gardn. BRAZIL: *Gardner 5704* (GH, NY, TYPE COLL.).

M. brachyanthera Ducke. BRAZIL: *Mexia 5964* (UC); *Ducke 35737* (HJBR); *Ducke 10870* (HJBR).

**M. brachypoda* Urban & Ekman. HAITI: *Ekman 6064* (US, TYPE COLL.). SANTO DOMINGO: *Ekman H14694* (NY); *Ekman H6257* (A).

M. brevipes Benth. SURINAM: *B. W. 1506* (Ch); *Utrecht Herb. 1506* (US); *Plantae Surinamenses 1506* (NY). BRAZIL: *Ducke 27605* (HJBR).

M. brunneicalyx Standley. PANAMA: *Seibert 609* (A).

M. buxifolia Urban. SANTO DOMINGO: *Ekman 11295* (A).

M. cauliflora DC. BRAZIL: *Ducke 25517* (HJBR, US). PERU: *Klug 1374* (Ch).

M. cearensis Huber. BRAZIL: *Ducke 14378* (HJBR).

M. Chamissoana Cogn. BRAZIL: *Glaziou 44803* (Ch); *Hoehne 29921* (NY); *Sellow 473* (US); *Porto 10759* (HJBR); *Ducke 6561* (HJBR).

M. Chamissoana var. *paulistana* Hoehne. BRAZIL: *Hoehne 29921* (Ch); *Hoehne 27704* (A).

M. ciliata Gleason. BRAZIL: *Krukoff 5478* (UC).

M. collocarpa Ducke. BRAZIL: *Ducke 299* (US); *Ducke 25516* (HJBR); *Ducke 35740* (HJBR).

M. crassifolia Sagot. FRENCH GUIANA: *Mélinon* in 1862 (Ch); *Mélinon* in 1864 (A). SURINAM: *Utrecht Herb. 3358* (US). BRAZIL: *Ducke 27624* (HJBR).

M. cyphocarpa Standley. BRITISH HONDURAS: *Schipp 70* (UC); *Gentle 2126* (NY); *Lundell 6945* (US). MEXICO: *Williams 9398* (A).

M. densifoliata Ducke. BRAZIL: *Ducke 801* (M); *Ducke 50951* (HJBR).

M. domingensis Spach. SANTO DOMINGO: *Ricksecker 477* (UC). HAITI: *Ekman H4209* (NY, US); *Ekman H5121* (A).

M. Doriana Saldanha. BRAZIL: *Brade 11203* (GH); *Saldanha 14418* (HJBR).

M. dumetosa Cogn. BRAZIL: *Ducke 22518* (HJBR, US).

M. elliptica Mart. BRAZIL: *Capanema 10620* (HJBR).

**M. emarginata* Griseb. CUBA: *Wright 2467* (M, TYPE COLL.); *Ekman 7443* (NY); *Ekman 9280* (US).

M. eugeniaefolia Spruce. BRAZIL: *Spruce*, Dec.–Mar. 1850 (GH).

M. exilis Gleason. GUATEMALA: *Wilson 407* (Ch). BRITISH HONDURAS: *Schipp 70* (NY); *Gentle 2927* (A).

M. floribunda Markgraf. PERU: *Mexia 6187* (UC).

M. Gardneri Triana. BRAZIL: *Gardner 2863* (GH); *Gardner 4154* (NY).
**M. Gleasoniana* Standley. MEXICO: *Matuda 3093* (Ch, TYPE COLL.). GUATEMALA: *Steyermark 39525* (Ch).
M. grandiflora DC. PERU: *Williams 8128* (Ch). BRAZIL: *Ducke 18504* (HJBR).
M. guianensis Aubl. BRAZIL: *Drouet 2356* (UC); *Krukoff 11926* (NY); *Krukoff 6613* (A); *Huber 10873* (HJBR); HJBR, Amazonas. FRENCH GUIANA: *Broadway 434* (US). VENEZUELA: *Williams 11600* (US).
M. Helleri Britton. PUERTO RICO: *Heller 1372* (Ch, NY).
**M. hottensis* Urban & Ekman. HAITI: *Ekman 10399* (A, US, TYPE COLL.).
M. Huberi Cogn. BRAZIL: *Mexia 5980* (UC); HJBR, Pará.
**M. lanceolata* Griseb. CUBA: *Wright 1235* (M, TYPE COLL.); *Ekman 15810* (US).
M. Lisboae Huber. BRAZIL: *Lisboa 11462* (HJBR).
**M. maestralis* Urban. CUBA: *Ekman 9350* (NY, US, TYPE COLL.).
M. Marshallii Burtt Davy & Sandwith. TRINIDAD: *Russell 1265–9* (NY).
**M. micradenia* Ducke. BRAZIL: *Ducke 25520* (HJBR, US, TYPE COLL.).
M. monantha Urban. CUBA: *Ekman 4415* (US).
M. Muelleri Cogn. MEXICO: *Matuda 3339* (M); *Matuda 3093* (A); *Reko 3817* (US).
M. myrtifolia Spruce. BRAZIL: *Krukoff 1371* (A, UC); *Krukoff 1407* (A); *Ducke 14379* (HJBR).
M. myrtilloides Poir. CUBA: *Herb. Richard* (Ch). JAMAICA: *Britton 3998* (NY); *Harris & Britton 10629* (US).
M. nervosa Pilger. BRAZIL: *Ducke 205* (A); *Ducke 14388* (HJBR).
M. oligantha Pilger. PERU: *Williams 3904* (Ch).
M. parvifolia Benth. MEXICO: *LeSueur 647* (GH). BRITISH HONDURAS: *Gentle 44* (UC); *Schipp 124* (UC); *Lundell 483* (UC); *Gentle 3712* (NY); *Bartlett 13132* (US). PANAMA: *Pittier 5711* (US); *C. L. Wilson* acc. No. *101* (Dart). ECUADOR: *Rimbach 92* (NY, US). BOLIVIA: *Steinbach 7582* (GH).
M. Petroniana Cogn. & Sald. BRAZIL: *Glaziou 13860* (Ch); *Almeida 48224* (HJBR).
M. Plasschaerti Pulle. BRAZIL: *Ducke 17234* (US); *Ducke 14383* (HJBR).
M. princeps Naud. BRAZIL: *Krukoff 5459* (UC); *Krukoff 8412* (A); *Krukoff 5986* (A); HJBR No. *27622*. PERU: *Killip & Smith 29761* (Ch).
M. pseudo-geminata Pittier. VENEZUELA: *Williams 10182* (Ch).
M. Pusa Gardn. BRAZIL: *Glaziou 19348* (Ch); *Gardner 2596* (NY, US); *Brade & Barreto 45553* (HJBR); *Ducke 14392* (HJBR).
M. rhizophoraefolia Triana. TOBAGO: *Broadway 4622* (Ch, US); *Broadway 3976* (GH).
**M. rostrata* Urban. CUBA: *Ekman 14069* (GH, US, TYPE COLL.); *Collector?* (NY).
M. Sagotiana Triana. SURINAM: *B. W. 5475* (Ch). PERU: *Klug 1501* (US). BRAZIL: *Ducke 10866* (HJBR); HJBR, no locality given.
**M. samanensis* Urban. SANTO DOMINGO: *Abbott 2233* (M, TYPE COLL.); *Ekman 15180* (A); *Ekman 14895* (A).
M. Sideroxylon Sagot. PERU: *Killip & Smith 26845* (Ch, US).
M. spathulata Griseb. CUBA: *Shafer 3254* (US); *Wright 1234* (GH).
M. "aff. *spathulata* Griseb." PUERTO RICO: *Sintensis 6195* (A); *Sintensis 6095* (US).
**M. Steyermarkii* Standley. GUATEMALA: *Steyermark 39446* (Ch, TYPE COLL.).
**M. subumbellata* Triana. BRAZIL: *Spruce 2004* (GH, TYPE COLL.).
**M. trunciflora* Ducke. BRAZIL: *Ducke 16937* (US, TYPE COLL.); *Capucho 456* (Ch); *Ducke 10839* (HJBR).
M. Ulei Pilger. BRAZIL: *Ducke 205* (Ch); *Ule 7677* (US); HJBR, Pará.
**M. Valenzuelana* A. Rich. CUBA: *Wright 2468* (M, TYPE COLL.); *Ekman 13845* (A, Ch, NY, US).
M. vernicosa Naud. FRENCH GUIANA: *Mélinon 189* (Ch); *Martin* s.n. (GH). SURINAM: HJBR, no locality given.
M. Weddellii Naud. BRAZIL: *Gardner 2595* (US); *Lützelberg 5998* (HJBR).
M. sp. BRAZIL: *Krukoff 6565* (A).
M. sp. BRAZIL: *Krukoff 6706* (A).

M. sp. Brazil: *Ducke 44* (A).
M. sp. Brazil: *Ducke 173* (A).
M. sp. Brazil: *Ducke 299* (A).
M. sp. Cuba: *Acuña 12602* (Cu).
M. sp. Cuba: *Acuña 12603* (Cu).
M. sp. Cuba: *Acuña 12604* (Cu).
M. sp. Cuba: *Acuña 7724* (Cu).
M. sp. Cuba: *Bucher 191* (Cu).
M. sp. Cuba: *Roig 61* (NY).

TECHNIQUE

Most of the data presented in this paper are based upon the study of cleared leaves. The technique consists in removing the pigments by treatment with 5% NaOH in an electric oven followed by dehydration in alcohol and clearing in xylene. The preparations were mounted directly in balsam without staining. In the case of large-leaved species, comparable portions of the lamina including the marginal and midrib areas were used. In many of the small-leaved species, the entire cleared lamina could be mounted beneath the cover-glass.

The study of cleared leaves was supplemented, when necessary, by hand-sections and by macerations. In most instances, the sclereids could be readily isolated from the surrounding leaf-tissue by teasing apart small portions of the thoroughly cleared laminae in a drop of water on a slide. The use of acid-alcohol followed by treatment with very dilute ammonium oxalate was particularly helpful where the sclereids are firmly adherent to the mesophyll and epidermal cells. In all cases the isolated sclereids were mounted directly from water into glycerine jelly.

DISTRIBUTION OF SCLEREIDS IN THE LAMINA

One of the most interesting and unexpected results of this study was the discovery that, throughout the species examined, the sclereids tend to be restricted to the ultimate ends of the veinlets (*figs. 1–15, 31–34*). This prevailingly *terminal position* of the foliar sclereids in *Mouriria* contrasts strikingly with the more usual *diffuse* distribution of such cells in the leaves of other dicotyledons (5, 9, 10, 11, 20). Despite the relatively large number of species studied by van Tieghem (21), he overlooked this definitive topographical feature of *Mouriria*, as did Palézieux (15), probably because both investigators made their observations largely on leaf-sections. A more detailed discussion of the morphological and ontogenetic implications of the terminal position of the sclereids will be deferred until the various sclereid-types in *Mouriria* have been described.

In addition to terminal sclereids, a number of species examined develop small unbranched sclereids in the tissues of the midrib and the short petiole. These sclereids occur either as solitary cells or are clustered, and appear to fluctuate in abundance even within the same species. Somewhat similar cells, with numerous pits, were also found lying free in the mesophyll

of the leaves of *M. angustifolia*, *M. cauliflora*, *M. cyphocarpa*, *M. exilis*, *M. oligantha*, and *M. trunciflora* (*figs. 10, 21*). In these species, the diffuse sclereids tend to be most numerous in the vicinity of the midrib and the larger veins but their distribution and abundance fluctuate considerably. In *M. oligantha*, for example, small diffuse sclereids were encountered even in the extreme marginal region of the lamina scattered among the large, irregularly branched terminal sclereids.

SCLEREID TYPES

In agreement with the observations of van Tieghem (21), the present survey reveals an extraordinary range in the form of the foliar sclereids in *Mouriria*. The majority of the species develop more or less conspicuously branched sclereids which vary widely in respect to the form of the cell-body and the position and extent of the system of branches. In marked contrast, a relatively few species exhibit remarkable filiform sclereids which resemble slender fibers in their form and unbranched character. These two extremes in sclereid form, however, cannot be sharply demarcated, because of intergradations and because of the strong tendency to fluctuation within many of the entities which have been studied. Under these circumstances, a classification of sclereids based on cell-form must be sufficiently elastic to include not only the outstanding "types" but also the intergradations which exist between them. From this standpoint, a morphological classification of the foliar sclereids of *Mouriria* is now presented. The sequence of arrangement of the four main "types" is mainly one of convenience and is not intended to represent a "phylogenetic series." On the contrary there is no reliable clue at present as to which of these types is "primitive." Therefore such terms as "rudimentary" and "highly developed" are used in a descriptive sense only and carry no evolutionary implications.

TYPE I. The sclereids grouped under this type are characterized by their parenchymatous form and rudimentary branches. Their position is prevailingly terminal at the ends of the veinlets throughout the nineteen species in which they have been encountered. In three species[1], *M. myrtifolia* (all collections except *Ducke 14379*), *M. vernicosa*, and *M. brachyanthera*, occasional sclereids, similar to those at the vein-endings, develop independently within the mesophyll. The sclereids, in the simplest cases observed, are spheroidal cells, unbranched or provided with irregular and short radiating arms. Cells of this kind occur in the leaves of *M. myrtifolia*, *M. Sagotiana*, *M. Valenzuelana*, and *M. vernicosa*. In these species, the secondary wall of the sclereids fluctuates widely in thickness, not only between the different entities but even within the same leaf (*figs. 1, 2*). A more complex and consistently branched kind of spheroidal sclereid was

[1] If no citations to specimens accompany the name of a species in this article it is to be assumed that *all* of the collections of this entity studied exhibit the same morphological type of sclereid.

found in the leaves of *M. angustifolia*, *M. brachyanthera*, *M. Huberi* (*Mexia 5980*), *M. nervosa*, *M. Plasschaerti*, *M. Sideroxylon*, and *M. Ulei* (*Ducke 205*). In these forms, the relatively thick-walled sclereids possess numerous radiating branches which very frequently dichotomize at their tips (*fig. 3*). Sclereids of a fundamentally similar type were also encountered in the leaves of *M. acuta*, *M. marginata*, *M. parvifolia*, and *M. myrtilloides* (*Britton 3998*, *Harris & Britton 10629*). The sclereids in these species tend to develop a more irregular cell-body but they are not sharply distinct from the spheroidal-branched forms described above (*fig. 4*).

Type II. Within this category the writer has attempted to segregate a complex series of ramified sclereids which vary considerably in size, form of the cell-body, and degree of development of the branch-system. Among the extremes in specialization within this polymorphic group are the stellate forms typical for example of the leaves of *M. princeps*, *M. micradenia*, and *M. ciliata* (*figs. 6, 7*), the dichotomously lobed sclereids with short acute branches which occur in *M. trunciflora* and *M. Helleri* (*figs. 8–10*), and the bizarre fusiform irregularly branched cells which are found in the leaves of *M. oligantha*, *M. Chamissoana* var. *paulistana*, and *M. Marshallii* (*figs. 13–15*). Many fluctuating and intermediate forms occur between these extremes and preclude any efforts at a rigid system of classification. Indeed it seems entirely possible that the examination of a wider range of leaf material than has been possible in this study would reveal even more extensive variations. For purposes of convenience in discussion, however, two rather well-defined trends of specialization are recognized.

(1) *Stellately branched sclereids.* These remarkable cells are characterized by the possession of relatively long and often dichotomizing arms which radiate in various directions from the irregular cell-body (*figs. 5–7*). In some cases, the tips of the vertical arms may reach the inner walls of one or both epidermal layers, but the major portion of the branch-system is confined within the mesophyll. Sclereids of this kind are prevailingly terminal in position, although in *M. rostrata*, *M. monantha*, *M. domingensis*, and *M. grandiflora* occasional examples of isolated sclereids were seen. When the various species exhibiting stellately branched sclereids are compared, interesting and apparently consistent differences in the size, number, and character of the branches are evident. For example, the branch-system of the sclereids of *M. cyphocarpa* (all collections except *Williams 9398*) consists of a radiating series of dichotomizing arms which seem to represent merely a more vigorous development of the condition described for the sclereids of Type I (cf. *figs. 3* and *5*). A similar trend in development was also encountered in the sclereids of *M. exilis*. In contrast, the stellate sclereids of *M. princeps*, *M. grandiflora*, *M. ciliata*, *M. collocarpa*, and *M. acutiflora* var. *oligantha* develop long slender arms which extend both laterally and vertically through the mesophyll in a most distinctive manner. Often the arms of adjacent sclereids overlap

to varying degrees (*fig. 6*). The sclereids of *M. brunneicalyx*, *M. Weddellii*, and *M. micradenia* closely approach this condition but tend to be somewhat shorter and more irregularly branched (*fig. 7*). In a number of species, the main body of the sclereid, which is somewhat flattened and dichotomously lobed, develops a series of short irregular acute arms which extend toward each epidermal layer. This condition has been observed in *M. trunciflora*, *M. Helleri*, *M. monantha*, *M. buxifolia*, *M. samanensis*, *M. hottensis*, and *M.* "aff. *spathulata*" (*figs. 8–10*). Such sclereids, however, in the material examined tend to fluctuate in form and are not sharply demarcated from the more regular stellate types.

The sclereids of *M. brevipes*, although radiately branched, offer several points of morphological interest. In all the collections of this species examined, the sclereid-branches are unusually slender and often appear bent or twisted in a very distinctive manner. In some cases, small terminal portions of certain of the vertical branches extend between the epidermis and the adjacent mesophyll cells.

In concluding this discussion of stellately branched sclereids, it is necessary to correct the apparently erroneous statements of Palézieux (15, p. 76) that "spicular cells" (i.e. sclereids) are absent from the leaf of *M. domingensis*. His conclusions were based upon Puerto Rican material cited as "*Sintensis 5024*." The present investigation, utilizing one collection from Santo Domingo (*Rickseçker 477*) and two collections from Haiti (*Ekman H4209*, *Ekman H5121*), yields quite a different result. In all cases, small radiately branched terminal sclereids were seen, but they are extremely few in number and the majority of the veinlets terminate in normal tracheary elements. A re-examination of Palézieux's material, using large portions of cleared leaves, would therefore seem very desirable.

(2) *Fusiform-branched sclereids.* In a number of species, the sclereids tend to be more or less conspicuously elongated within the mesophyll and the branch-system is correspondingly irregular in character. This trend appears to varying degrees in the sclereids of *M. brachypoda*, *M. Gleasoniana* (*Matuda 3093*), *M. lanceolata* (*Wright 1235*), *M. spathulata* (*Wright 1234*), *M. Lisboae*, *M. sp.* (*Roig 61* from Cuba), and *M. sp.* (*Acuña 12602* from Cuba). Excellent examples are provided by the sclereids of *M. Muelleri*, which vary in form from short irregularly branched elements to cells provided with long fiber-like ends (*fig. 12*). In *M. acutiflora* the sclereids are more profusely branched, with the same tendency, however, to assume an elongated form (*fig. 11*). But the most striking examples of elongated ramified sclereids were observed in *M. Steyermarkii*, *M. oligantha*, *M. Chamissoana*, *M. Chamissoana* var. *paulistana*, and *M. Marshallii*. In each of these species the sclereids are so distinctive in their morphology that separate description is necessary.

In *M. Steyermarkii* the sclereids are extremely variable in form, ranging from irregularly branched cells with the tips of the branches often reaching the lower epidermis to slender and sparingly branched fiber-like elements. In sclereids of the latter type, the vertical branches are often restricted to

that portion of the element which is in direct contact with the end of the veinlet.

A very distinctive kind of sclereid was discovered in the leaf of *M. oligantha*. The terminal sclereids of this species are exceptionally large in size, very thick-walled, and provided with a series of relatively short, acute spicule-like branches (*fig. 13*). Although many sclereids are extremely irregular in form, there is a pronounced tendency to the development of a massive fiber-like cell body. When portions of the cleared leaf are observed from both surfaces, it is evident that very short dichotomizing terminations of certain of the branches extend beneath the adaxial epidermis and the mesophyll.

The sclereids of *M. Chamissoana* and *M. Chamissoana* var. *paulistana* are polymorphic to an unusual degree. When even small areas of the cleared leaf are examined it is evident that the range in variation includes (1) short rod-like elements with more or less truncated ends, (2) elongated fusiform cells with few or no branches, and (3) dichotomously branched elements which may appear Y- or X-shaped (*fig. 14*). In both the fusiform and branched types, the ultimate ends of the cell-body or its arms are blunt rather than acute. A careful study of the position of the sclereids in both of the above entities likewise reveals unusual fluctuation. Many of the veinlets terminate in solitary sclereids of varying form, but diffused sclereids of similar morphology are also frequent. In several instances, pairs of ramified interlocked sclereids were observed lying free in the mesophyll.

The situation in the leaf of *M. Marshallii* is one of the most remarkable encountered in this survey. The submarginal regions of the lamina are largely devoid of sclereids, and only rarely were peculiar thin-walled irregularly branched cells observed at the ends of the veinlets. On the contrary, typical sclereids, in the limited material of this species examined, are restricted to the lamina-margin, where they appear as a series of closely packed massive fiber-like cells (*fig. 15*). Branching is sparse and irregular and the secondary wall is thick and apparently conspicuously laminated. Careful examination of cleared material reveals that these sclereids are strictly terminal at the ends of the marginal veinlets.

Type III. In sclereids of this type, the greatly elongated axis of the cell extends obliquely or vertically through the entire mesophyll and branches more or less profusely beneath each epidermal layer. The characteristic orientation and distinctive branching of sclereids of this type is vividly illustrated in *M. Pusa*. When a thick transection of the cleared lamina of this species is examined, the sclereids appear as columnar elements with numerous overlapping branches extending beneath the lower and upper epidermis (*fig. 16*). As is evident in this figure, the main axis of these remarkable sclereids frequently dichotomizes, sending out two series of candelabra-like branches toward the upper or lower surface of the lamina. When viewed as isolated cells in macerated material, the sclereids of *M. Pusa* vary widely as to the length of the

terminal branches and their relative development at each end of a given cell. Very commonly the sclereid appears I-shaped because of the prominent development of two horizontal branches at each end of the cell (*fig. 37*). But many variants of this condition were noted, including T-shaped cells with short root-like branches at one end and forms with one or two candelabra-like branch-systems. The full extent and complexity of the branch-systems of the sclereids of *M. Pusa* is fully appreciated, however, only by the study of large portions of cleared leaves. When the adaxial surface of the lamina is viewed at a high plane of focus, the subepidermal branches of adjacent sclereids are seen to overlap and to interlock in a most intricate manner (*fig. 17*). In contrast, the branches which develop beneath the abaxial epidermis tend to be somewhat shorter and less crowded in appearance (*fig. 18*).

Sclereids of a similar morphological type are also found in the leaves of *M. rhizophoraefolia* and *M. Gardneri*. In the former the sclereids tend to be less profusely branched but otherwise are very similar to those of *M. Pusa*. But in *M. Gardneri* the subepidermal branch-systems attain a degree of development which is truly remarkable. As viewed from the adaxial surface, the complex radiating and dichotomizing branches of the sclereids collectively form an intricate mesh-work (*fig. 19*). This condition is equally apparent when the abaxial surface of the lamina is examined (*fig. 20*). Here the sclereid-branches are very tightly interlocked and the meshes of the reticulum are occupied by the prominent stomatal crypts which are characteristic of a number of species of *Mouriria* (21, pp. 47–48, *pl. 2, figs. 11–15*).

Columnar branched sclereids were also encountered in the leaves of *M. cauliflora* and *M. abnormis*. In these species, however, the subepidermal branch-systems are somewhat different in character and are much less extensively developed than in *M. Pusa* and *M. Gardneri*. When cleared leaves of *M. cauliflora*, for example, are examined at a high level of focus, it is evident that a considerable portion of the branch-systems of the rather widely spaced sclereids extends in a dendroid manner below the epidermis (*fig. 21*). Instructive views of the distinctive sclereids of this species are furnished by macerations. These reveal that the sclereids are columnar in form with remarkable dendroid branch-systems at each end (*fig. 35*). Often the main axis of the sclereid dichotomizes, thus producing a series of candelabra-like branches (*fig.* 36). The sclereids of *M. abnormis* are rather similar morphologically, differing mainly in the more conspicuous tendency of the main axis to fork.

With respect to position, the branched sclereids of *M. Pusa*, *M. rhizophoraefolia*, and *M. cauliflora* are strictly terminal at the ends of the veinlets. In *M. abnormis*, however, many of the columnar sclereids develop independently of the vascular system within the mesophyll. Unfortunately no decision could be reached with reference to *M. Gardneri*, because clear views of the veinlets are obscured by the profuse subepidermal branch-systems of the sclereids.

TYPE IV. The sclereids included under this type are distinguished by

their slender greatly elongated form and by their peculiar orientation within the leaf. They were encountered in only nine of the species investigated and are among the most bizarre of the foliar idioblasts found in *Mouriria*.

The striking features of this type of sclereid are well illustrated in *M. anomala*. As seen in transectional view, the lamina of this species appears to be permeated by a tangled series of thread-like cells which traverse the mesophyll in the most varied directions and extend beneath the epidermal layers (*fig. 22*). The general impression is that of a "diseased leaf" thoroughly penetrated by a fungus mycelium, an impression which is further strengthened when the adaxial surface of cleared leaves is viewed at a high plane of focus (*fig. 23*). As seen from this aspect the sclereids appear as slender intertwined filiform elements, many of which extend horizontally for a considerable distance beneath the epidermis. An essentially similar appearance is presented when the cleared leaf is examined from the abaxial surface, except that the sclereids "avoid" the stomatal crypts. The latter appear singly or in groups bordered by the interlaced and overlapping ends of the sclereids. A careful inspection of *figure 22* will show that a number of the sclereids follow an oblique undulating course through the mesophyll, their opposed ends terminating below the upper and lower epidermis (cf. also 21, *pl. 2, fig. 7*). Whether this is invariably the orientation of every sclereid is impossible to decide because of the great length and tortuous path of many of the cells. The ultimate solution of this question must come from a study of the complete history of development of the sclereids.

Sclereids entirely similar in form to those of *M. anomala* also occur in the leaves of *M. subumbellata*, *M. crassifolia*, *M. Apiranga*, and *M. eugeniaefolia*. In these species the sclereids are extremely long and are well developed beneath the epidermis, where they are arranged in complex intertwined groups (*figs. 24, 28*). This arrangement is also shown in a striking fashion at the extreme marginal region of the lamina, where the filiform sclereids are very closely packed and only occasional free tips are evident (*fig. 25*).

When isolated by maceration, the sclereids of this type appear as long, acuminate fiber-like cells which are bent or twisted to various degrees, as would be expected from their peculiar orientation within the lamina (*fig. 39*). In all of the species mentioned above, occasional sclereids fork at one or both ends and in addition may be provided with a few short spicule-like branches.

The relation of sclereids of this type to the veinlets could only be satisfactorily determined in *M. Apiranga*. In one of the collections of this species (*da Costa 124*) it was possible to find certain areas in the cleared leaf where the attachment of sclereids to the ends of the veinlets was unmistakable. Whether in this and the other four species the sclereids are *prevailingly* terminal in position can be settled only by ontogenetic study.

For convenience, the writer has also included under Type IV the sclereids of *M. densifoliata*, *M. dumetosa*, *M. arborea*, and *M. Petroniana*.

In these species, the sclereids traverse the mesophyll in various directions but tend to branch, more or less profusely, beneath the epidermal layers. On the basis of morphology and orientation, these sclereids thus appear somewhat intermediate between Types III and IV. When the adaxial surface, for example, of the lamina of *M. densifoliata* is examined, the sclereids appear as acuminate unbranched cells which, except for their shorter extension beneath the epidermis, resemble the sclereids of *M. crassifolia* (cf. *figs. 24* and *26*). But when the abaxial surface of the leaf of *M. densifoliata* is studied it is clear that the ends of many of the sclereids are forked or irregularly branched, somewhat like the abaxial ends of the sclereids of *M. Pusa* (cf. *figs. 18* and *27*). This latter resemblance will be clearer by reference to *figure 38*, which depicts an isolated cell of *M. densifoliata*. This element is decidedly fiber-like at one end, while the opposite end is branched very much like that of the sclereid of *M. Pusa* (cf. *figs. 37* and *38*). In *M. dumetosa* a study of cleared leaf-sectors indicates that the sclereids are rather coarse fiber-like cells which branch abundantly under both epidermal layers.

The most striking examples of sclereids which seem to combine the morphological characteristics of Types III and IV were found in the leaves of *M. arborea* and *M. Petroniana*. In these species the terminal sclereids are very long slender cells, branched within the mesophyll and with delicate ramifications beneath each epidermal layer (*figs. 29, 30*). These sclereids appear to be "connecting links" between the extremes in specialization represented on the one hand by the idioblasts of *M. Pusa* and on the other by those of *M. Apiranga* (cf. *figs. 17* and *28* with *figs. 29* and *30*).

DISCUSSION AND SUMMARY

The wide range in sclereid-types which occurs in *Mouriria* and the dominant terminal position of these idioblasts represent problems of considerable morphological and taxonomic interest which will now be examined under two main topics.

(1) TERMINAL POSITION OF THE SCLEREIDS. Throughout the 69 species which have been studied, there is an unmistakable tendency for the sclereids to be restricted in position to the ends of the veinlets, regardless of their form or particular orientation within the leaf (*figs. 1–15, 31–34*). This distinctive topography, which has apparently not been observed in previous studies on angiosperm sclereids,[2] raises the question of the onto-

[2] The relation of the various sclereid-types to the veinlets in *Memecylon* deserves comparative study because of the presumably close systematic relationship of this genus to *Mouriria* (21, pp. 50–51). Although no attempt was made at a comprehensive survey, the writer discovered terminal sclereids in the leaves of the following species: *Memecylon Arnottianum* Wight ex Thwaites (*Thwaites 1589*, US), *M. obtusum* Wall. (*Helfer 126*, A), *M. oligoneuron* Bl. (*Elmer 21308*, *Ramos 1635*, *Yates 1216*, UC), *M. phyllanthifolium* Thwaites ex Clarke (*Thwaites 3901*, isotype US), *M. scutellatum* (Lour.) Naud. (*Ching 9757*, *McClure 20120*, UC; *Clemens 3313*, US), and *M. Spathandra* Bl. (*Linder 1305*, *Dinklage 2971*, *Kennedy 1844*, A; *Grossweiler 9189*, US).

genetic and phylogenetic origin of the sclereids in *Mouriria*. Are these idioblasts "homologous" with the tracheary or sclerenchymatous elements of the veinlets, or is their terminal position a topographical relationship devoid of morphological significance? Unfortunately, material suitable for ontogenetic study has not been secured by the writer and hence it is not clear whether the terminal sclereids originate from "procambial cells" in the developing veinlets or arise from adjacent cells of the "ground meristem."[3] The existence in certain species of both terminal as well as diffuse sclereids has already been mentioned, and developmental studies on the leaves of these plants would doubtless shed important light on the problem. It is of interest, however, that in several of the species investigated indirect evidence is found of the possibly close ontogenetic relationship between terminal sclereids and tracheary elements. The most striking illustration of this was encountered in the leaf of *M. maestralis*. In this Cuban endemic, typical thick-walled ramified sclereids are largely confined to the midrib and marginal regions of the lamina, and the majority of the veinlets terminate in cells intermediate in character between sclereids and tracheary elements. The "hybrid" character of these remarkable cells is shown by their tendency to produce sclereid-like lobes and branches and by the development of helical thickenings closely similar to those of protoxylem elements (*figs. 31–33*). Not infrequently a group of adjacent veinlets exhibits a series of remarkable intergradations between "normal" tracheary cells and thick-walled branched sclereids (*fig. 34*). Because the material available for study was restricted in amount, it is uncertain whether the presence of "transitional cells" represents a reliable diagnostic character of *M. maestralis*. The situation in *M. hottensis* clearly demonstrates the need for a cautious approach to such a problem. In one collection of this species (*Ekman 10399*, A) many of the veinlets terminate in hybrid-like cells similar to those in *M. maestralis*. But in a collection of *M. hottensis* bearing the same number, from the U. S. National Herbarium, the majority of the veinlets end in thick-walled irregularly branched sclereids. Such fluctuations make it plain that the question of the ontogenetic and phylogenetic relationships between sclereids and tracheary elements in *Mouriria* requires intensive as well as extensive study.

(*2*) Systematic value of the sclereids. The classification of sclereids proposed in this paper is based entirely on morphological characters and was not influenced by the opinions advanced by various writers as to the systematic affinities between the various species of the genus. This standpoint was obviously demanded, because (1) no comprehensive taxonomic revision of *Mouriria* has been attempted since the publication of Cogniaux's (7) monograph, and (2) a number of the entities used in the

[3] *Both* methods of origin occur in the case of the so-called "storage tracheids" found in the leaves of a number of angiosperms (16, pp. 46–50 and 60–62). In "*Capparis religiosa*" the terminal storage tracheids are branched and resemble, to some extent, certain of the sclereids which occur in *Mouriria* (16, *fig. 5*).

present survey may subsequently prove to have been incorrectly determined. For these reasons, the possible diagnostic value of the sclereids can be approached only in a most tentative manner.

First of all, it seems evident that the presence of terminal foliar sclereids is an important *generic character* of *Mouriria* which can be utilized especially in the identification of "sterile" or doubtful material. This was illustrated by the study of a series of unclassified specimens, presumably all belonging to *Mouriria*, obtained from the Arnold Arboretum. In one of these specimens (*Ducke 44*) long filiform sclereids, obviously of the type found in *M. crassifolia* and *M. anomala*, are present. In three specimens (*Krukoff 6565*, *Ducke 173*, *Ducke 299*) typical stellately branched terminal sclereids of a type common in *Mouriria* were encountered. But in *Krukoff 6706* peculiar diffuse sclereids, unrelated to the veinlets, occur. The true affinities of this specimen are obscure, but it does not appear to be a species of *Mouriria*. The generic value of sclereids was also illustrated by the study of a leaf-specimen, presumably of a *Mouriria*, received from the herbarium of the Missouri Botanical Garden under the specific epithet "*Gentlei*" (*Gentle 1684*). When cleared, this leaf proved devoid of sclereids, and a subsequent search in the literature revealed that the same collection was described as *Eugenia Gentlei* (Myrtaceae) by Lundell (13). A further example was provided by the contrast between the two collections of *M. Gleasoniana*. In the leaf of the type collection, from Mexico (*Matuda 3093*), ramified terminal sclereids very similar to those of *M. Muelleri* were found (cf. *fig. 12*). But in the specimen from Guatemala (*Steyermark 39525*) the leaf is entirely devoid of sclereids and, because of the presence of well developed secretory glands in the mesophyll, appears to represent an entity belonging to the Myrtaceae. In two of the species of *Mouriria* included in the present survey, *M. floribunda* (*Mexia 6187*), from Peru, and *M. pseudogeminata* (*Williams 10182*), from Venezuela, sclereids are absent from the lamina and the veinlets terminate in lobed or greatly enlarged helically thickened cells. These elements closely resemble the so-called "storage tracheids" of *Nepenthes* (16, *fig. 84*). On the basis of the very limited material available, it seems very doubtful to the writer that these specimens were correctly determined.

In any attempt to utilize sclereid-types as an aid in the distinction of species in *Mouriria*, full consideration must be given to the common tendency of sclereids, especially those of Type II, to fluctuate in form within the leaves of the same entity. To determine fully the limits of variation in each case requires the comparison of a much wider range of material than has been possible in the present survey. Nevertheless interesting results emerge when the available morphological data are applied to a discrete and apparently "representative" series of species. The 19 Amazonian species recently discussed from a taxonomic and a phytogeographic standpoint by Ducke (8) furnish very suitable material. In the first place there are included among these species a number of the

old and apparently very distinct entities which are treated by Cogniaux (7) in his monograph of *Mouriria*. Secondly, for each of these 19 species, the writer has assembled 2 or more separate leaf-collections, the comparison of which showed excellent general agreement as to sclereid-type. Finally, the specimens of five of the species bear the same number which is cited in Ducke's article. On the basis of sclereid-morphology these Amazonian species can be arranged in four groups as follows:

Group I includes *M. brachyanthera*, *M. Huberi* (*Mexia 5980*), *M. Plasschaerti*, *M. Ulei* (*Ducke 205*), *M. nervosa*, *M. Sagotiana*, *M. vernicosa*, and *M. myrtifolia*. In these species the sclereids are parenchymatous in form and are provided with rudimentary branches (*figs. 1–3*). No significant variations in sclereid-type were encountered except in *M. Ulei* (*HJBR* from Pará), *M. myrtifolia* (*Ducke 14379*), and *M. Huberi* (*HJBR* from Pará), in which the sclereids are more irregularly and profusely branched, resembling those of *M. elliptica* and *M. acutiflora* (*fig. 11*). On this point it is interesting to note that Ducke (8) states that *M. Huberi* is the only species of Amazonia belonging to the subgenus *Olisbea*. The latter was originally defined as one of the two "sections" of *Mouriria* by Cogniaux (7), to include *M. elliptica*, *M. rhizophoraefolia*, *M. arborea*, and *M. Petroniana*.

Group II includes *M. trunciflora*, *M. collocarpa*, *M. micradenia*, *M. grandiflora*, and *M. acutiflora*. The sclereids of all these species are profusely ramified but appear to differ from one another in the form of the cell and the extent of the branch-system (*figs. 7–11*). Because of this, the sclereids may ultimately prove useful in the differentiation of these five species. The presence of numerous small diffuse sclereids appears to be an additional diagnostic feature of *M. trunciflora* (*fig. 10*).

Group III includes *M. cauliflora*, which appears very distinctive because of (1) the columnar terminal sclereids with their subepidermal branch-systems, and (2) the presence of parenchymatous diffuse sclereids (*figs. 21, 35, 36*). *Mouriria guianensis* may also belong in this group, although this species has proved the most variable of all the entities investigated with respect to sclereid-morphology. In some collections (*Drouet 2356*) the terminal sclereids are irregular columnar cells which branch irregularly beneath the upper epidermis of the leaf. In other collections (*Williams 11600, Krukoff 6613*) the sclereids closely approach the type found in *M. acutiflora*. Because of such fluctuations it seems possible that the writer's leaf-collections of *M. guianensis* may represent several distinct entities.

Group IV includes *M. anomala*, *M. crassifolia*, *M. Apiranga*, and *M. dumetosa*. In these species the sclereids are greatly elongated fiber-like cells branched to varying degrees beneath the epidermis and oriented in a most distinctive manner in the leaf (*figs. 22–24, 28, 39*).

Whether these "species groups" just defined on the basis of sclereid-morphology are composed of entities which are closely related in other respects is open to question. In this connection it is worthy of note that

Cogniaux's (7) division of *Mouriria* into two sections results in the *separation* of species which exhibit similar morphological types of sclereids. Thus, for example, *M. Gardneri* and *M. Pusa* are classed by Cogniaux under the section *Eumouriria*, while *M. rhizophoraefolia* is placed in the section *Olisbea*. All three species, however, form distinctive columnar sclereids which branch more or less profusely beneath the epidermal layers (*figs. 16–20*). Similarly *M. arborea* and *M. Petroniana* are segregated from *M. crassifolia*, *M. dumetosa*, *M. eugeniaefolia*, *M. subumbellata*, and *M. Apiranga*, although all of these species possess slender fiber-like sclereids which are among the most distinctive idioblasts in the genus (*figs. 22–25, 28–30*). Such apparent discrepancies, however, do not necessarily indicate that sclereid-characters are less reliable than other morphological criteria[4] in judging affinities between species. On the contrary, it is clear that the ideal approach to the systematics of *Mouriria* should involve the comparison and correlation of a wide range of morphological features, including floral structure as well as the histology of the leaf and stem. The important results which emerge from a broad attack of this sort are illustrated by the recent collaborative studies of Smith (17, 18, 19), Bailey and Nast (1, 2, 3, 4, 5, 6), and Nast (14) on the Winteraceae.

[4] Cogniaux (7) used certain characters of the calyx and pollen as the bases for his two sections of *Mouriria*.

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EXPLANATION OF PLATES

PLATE I

Cleared leaves showing terminal sclereids of Type I. Magnification × 140. FIG. 1. *M. myrtifolia* Spruce, *Krukoff 1371.* FIG. 2. *M. Sagotiana* Triana, *Klug 1501.* FIG. 3. *M. brachyanthera* Ducke, *Mexia 5964.* FIG. 4. *M. emarginata* Griseb., *Ekman 9280.*

PLATE II

Cleared leaves showing terminal sclereids of Type II. Magnification × 140. FIG. 5. *M. cyphocarpa* Standley, *Schipp 70.* FIG. 6. *M. princeps* Naud., *Krukoff 5459.* FIG. 7. *M. micradenia* Ducke, *Ducke 25520.* FIG. 8. *M. Helleri* Britton, *Heller 1372.*

PLATE III

Cleared leaves showing terminal sclereids of Type II. Magnification × 140. FIG. 9. *M. trunciflora* Ducke, *Ducke 16937.* FIG. 10. A different region of the same leaf shown in *fig. 9.* Note small diffuse sclereids in mesophyll and along the two veins. FIG. 11. *M. acutiflora* Naud., *Ule 7677.* FIG. 12. *M. Muelleri* Cogn., *Matuda 3093.*

PLATE IV

Cleared leaves showing terminal sclereids of Type II. Magnification × 140. FIG. 13. *M. oligantha* Pilger, *Williams 3904.* The globoid structures in the center and right-hand portions of the figure are masses of crystals. FIG. 14. *M. Chamissoana* var. *paulistana* Hoehne, *Hoehne 29921.* FIG. 15. *M. Marshallii* Burtt Davy & Sandwith, *Russell 1265–9.* Margin of lamina showing large fusiform-branched sclereids. The dark bodies near the sclereids are masses of crystals.

PLATE V

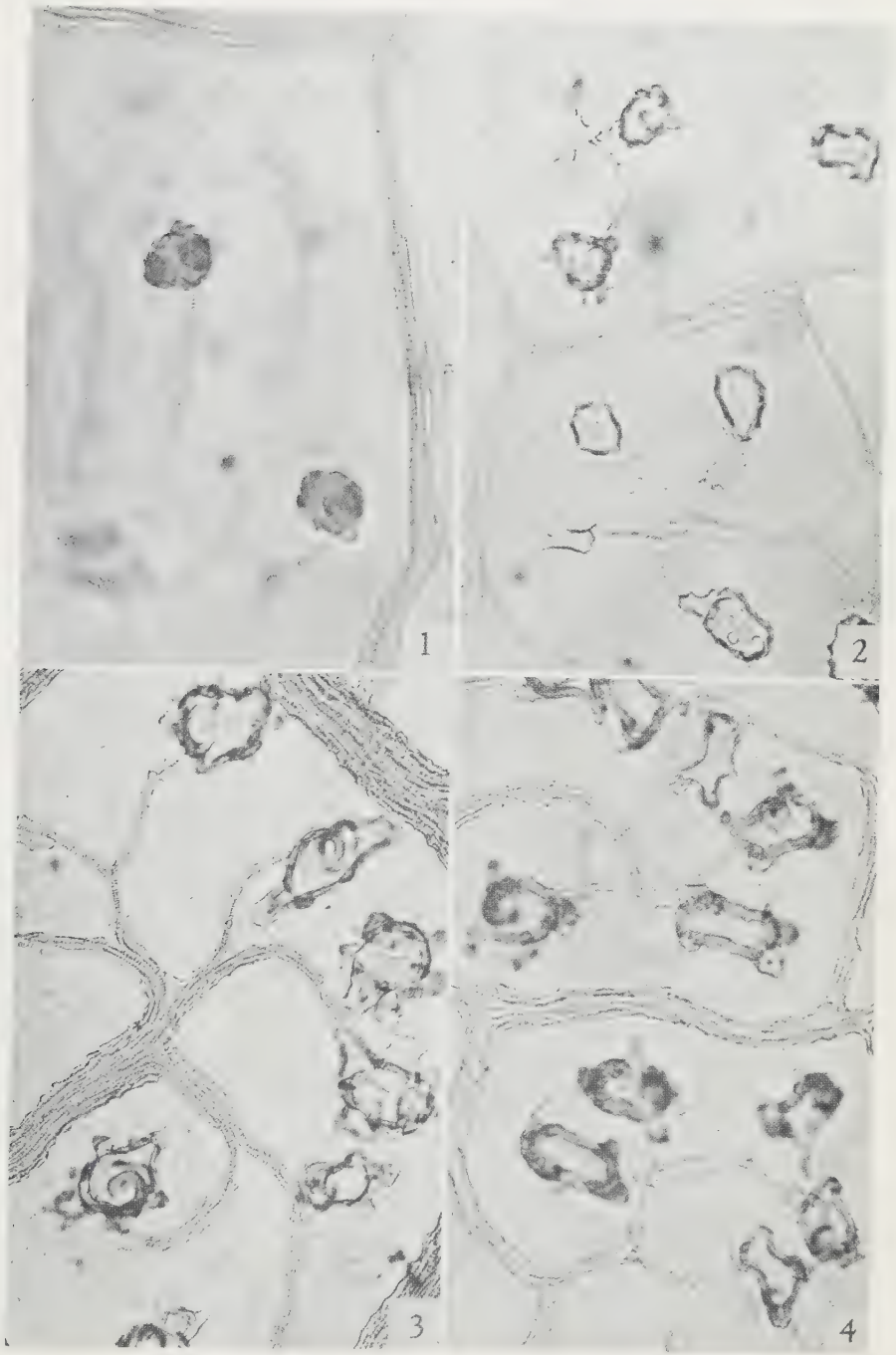
Cleared leaves of *M. Pusa* Gardn., *Gardner 2596,* illustrating form and orientation of Type III sclereids. Magnification × 140. FIG. 16. Thick transection of lamina showing columnar sclereids branched beneath the epidermal layers. Note veinlet in center of figure. FIG. 17. Adaxial surface of lamina showing sclereid-branches under the epidermis. FIG. 18. Abaxial surface of lamina showing sclereid-branches under the epidermis.

PLATE VI

Cleared leaves illustrating sclereids of Type III. Magnification × 140. FIG. 19. *M. Gardneri* Triana, *Gardner 2863.* Adaxial surface of lamina showing the profusely developed subepidermal branch-systems of the sclereids. FIG. 20. Abaxial surface of a portion of the same leaf shown in *fig. 19.* The stomatal crypts, appearing as oval areas, are bordered by the tightly interlocked subepidermal branches of the sclereids. FIG. 21. *M. cauliflora* DC., *Ducke 25517.* Abaxial surface of lamina showing dendroid branching of the terminal sclereids beneath the epidermis. Note the small parenchymatous diffuse sclereids lying in the mesophyll.

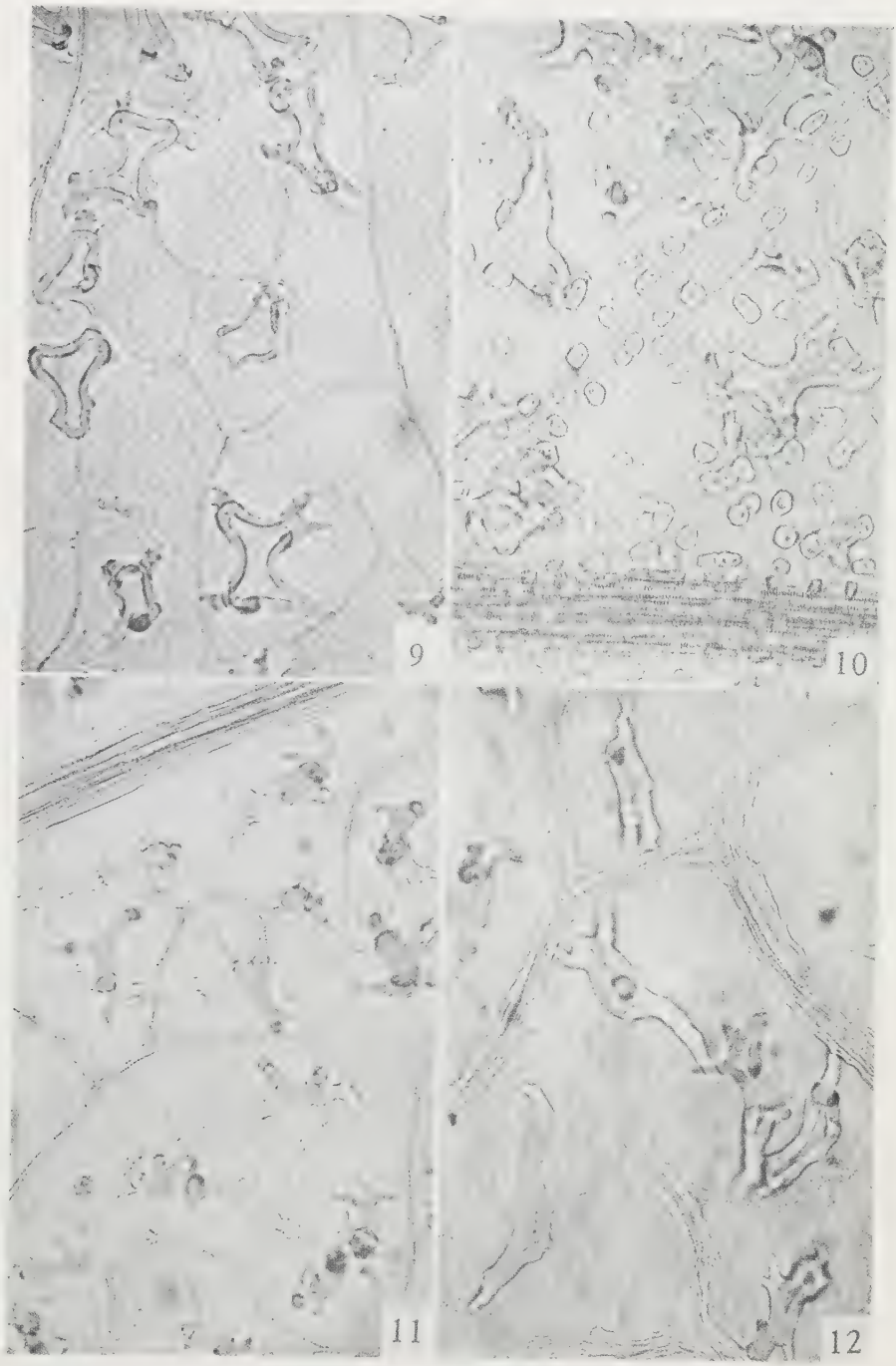
PLATE VII

Cleared leaves illustrating sclereids of Type IV. Magnification × 140. FIG. 22. *M. anomala* Pulle, *Ducke 14373.* Thick transection of lamina showing the very numerous intertwined filiform sclereids which traverse the mesophyll region and extend beneath the epidermal layers. FIG. 23. Adaxial surface of a portion of the

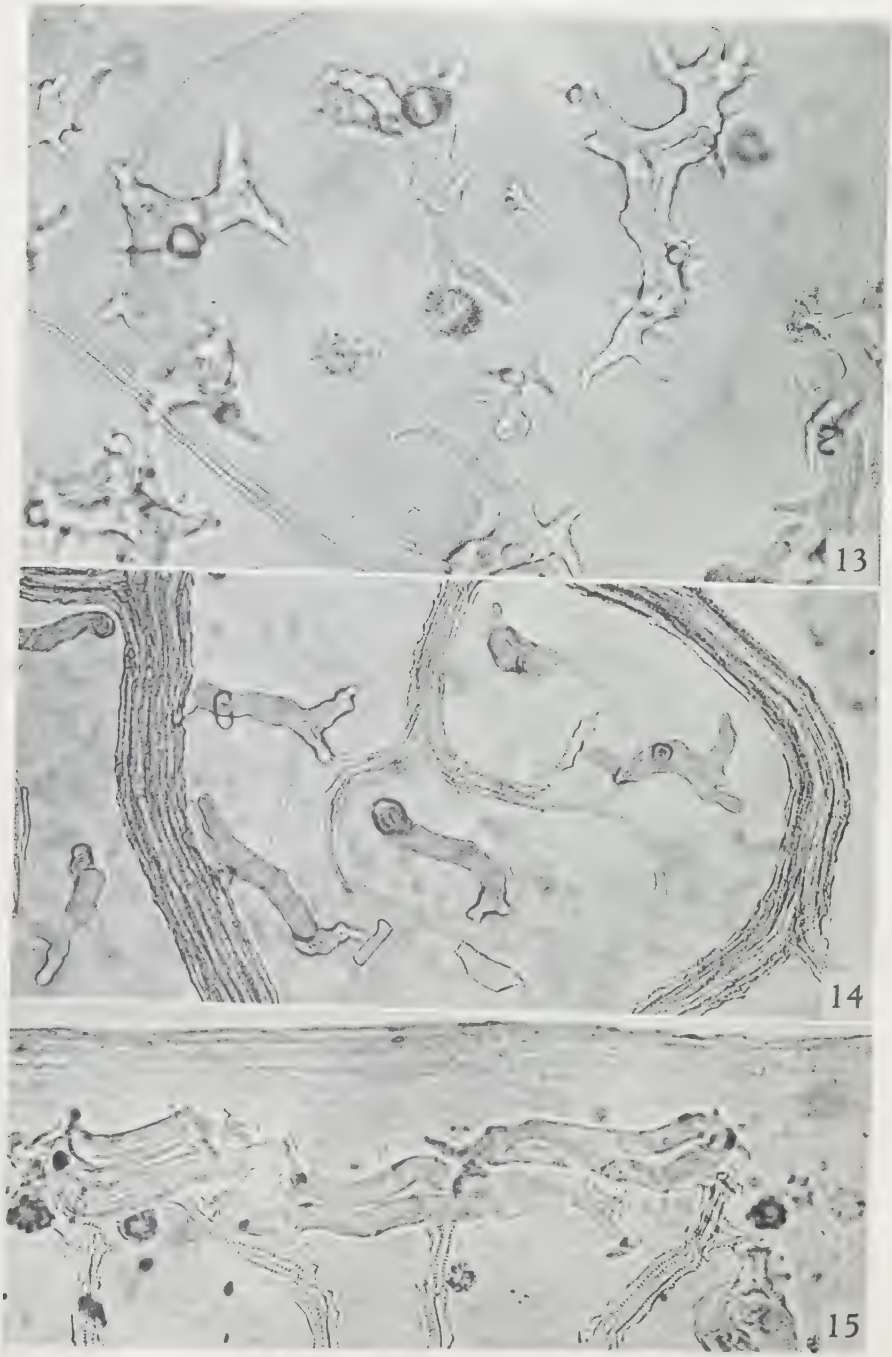


Foliar Sclereids in Mouriria

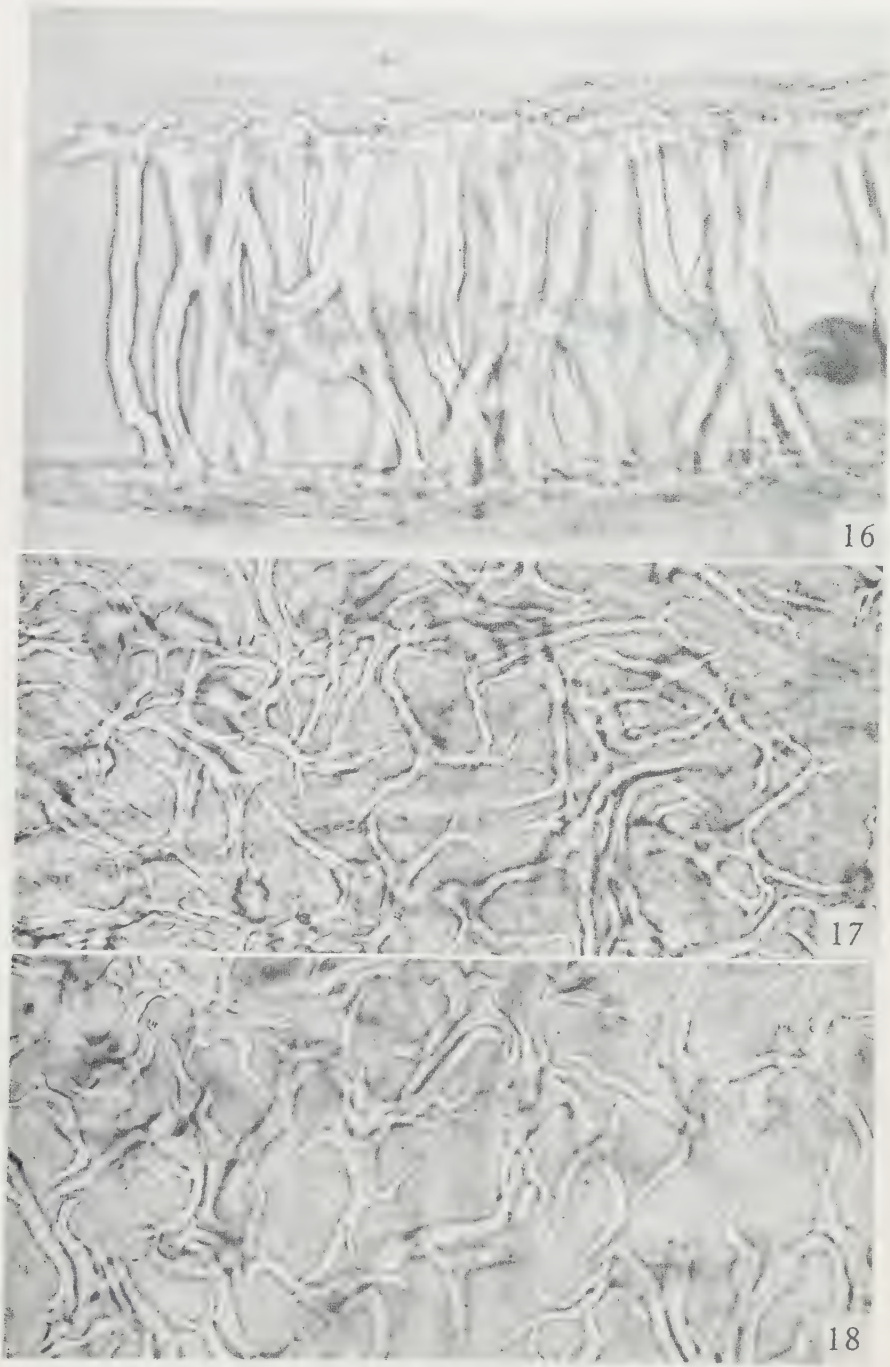
Foliar Sclereids in Mouriria



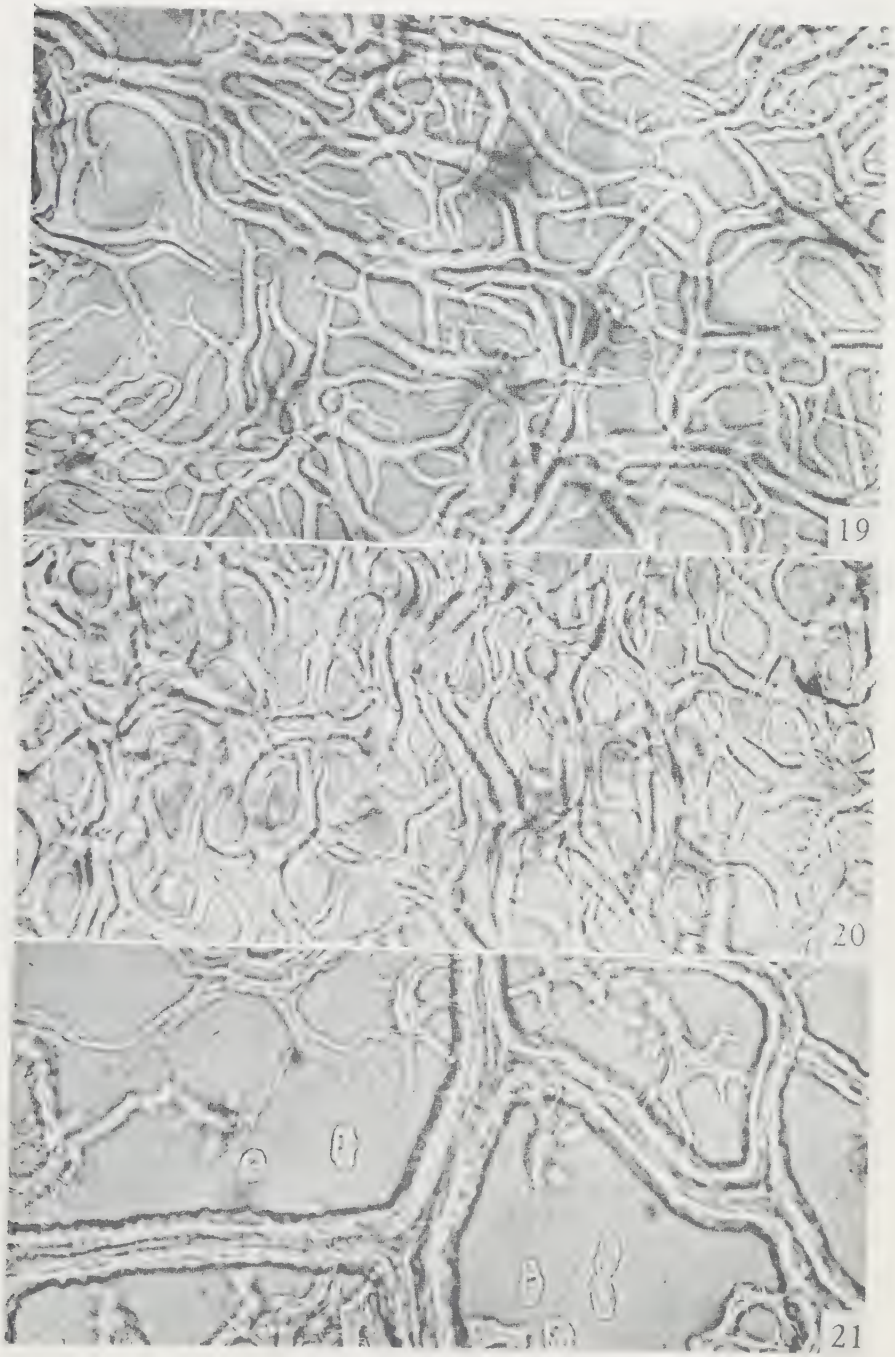
Foliar Sclereids in Mouriria



Foliar Sclereids in Mouriria



Foliar Sclereids in Mouriria



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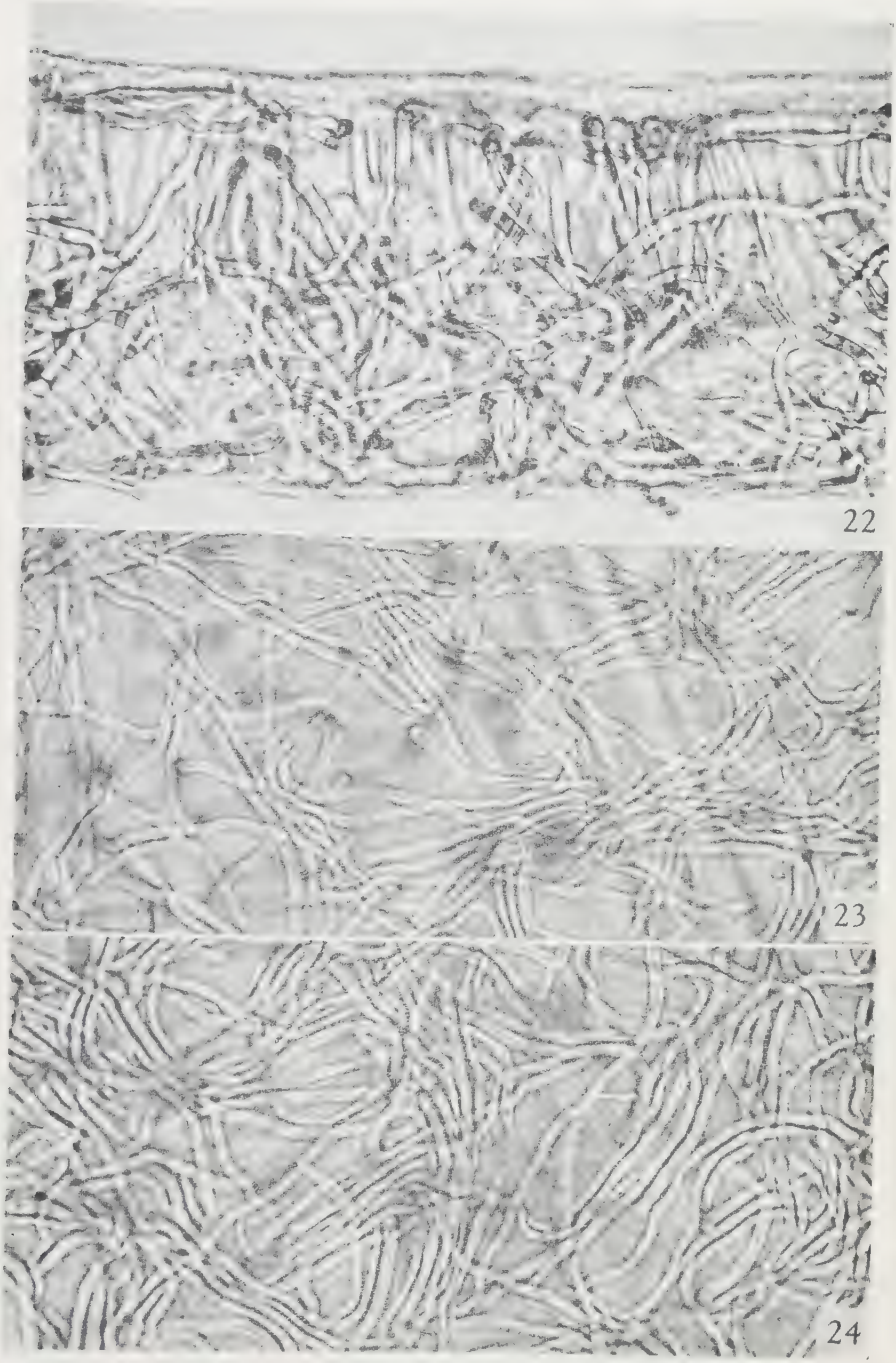

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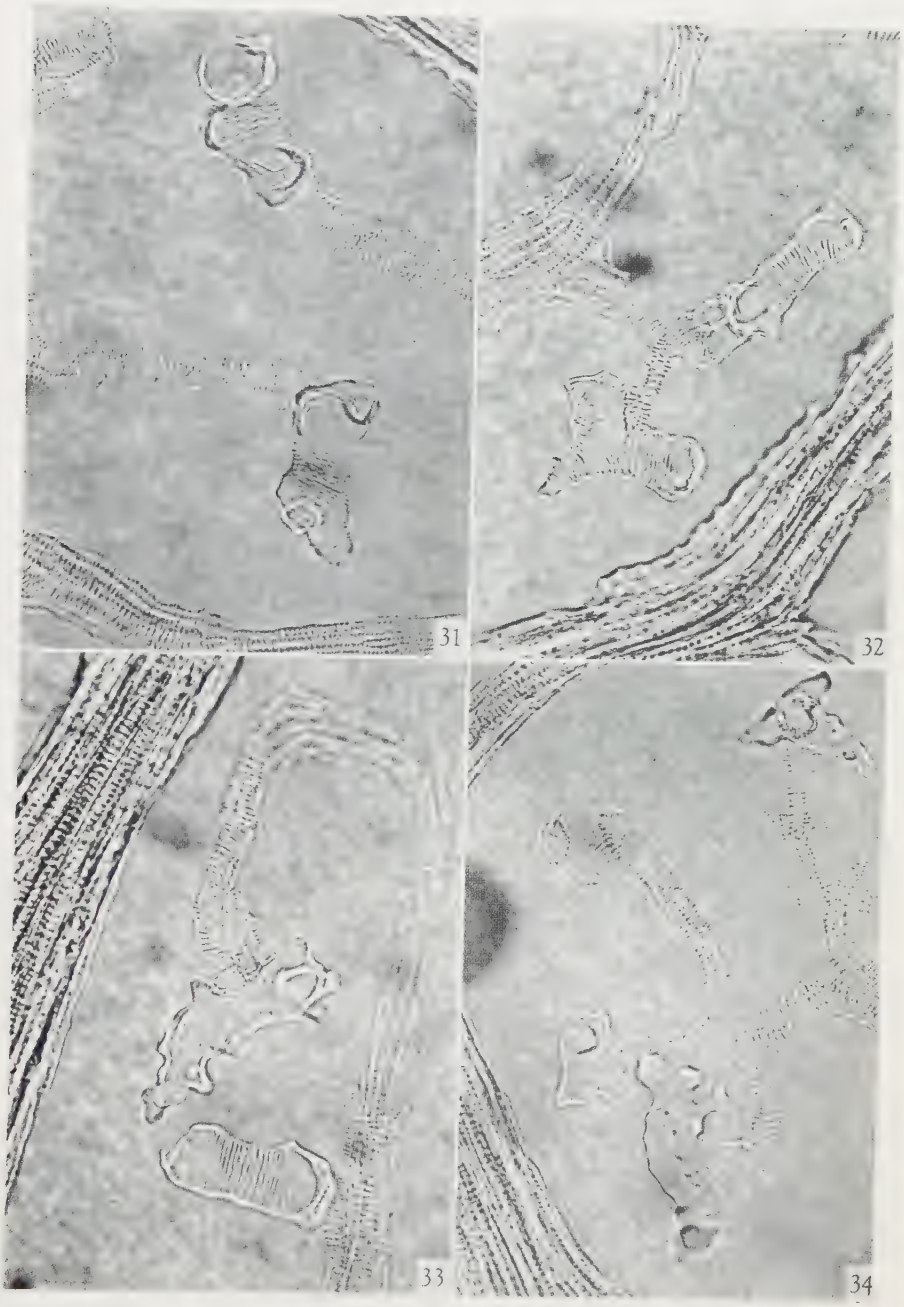

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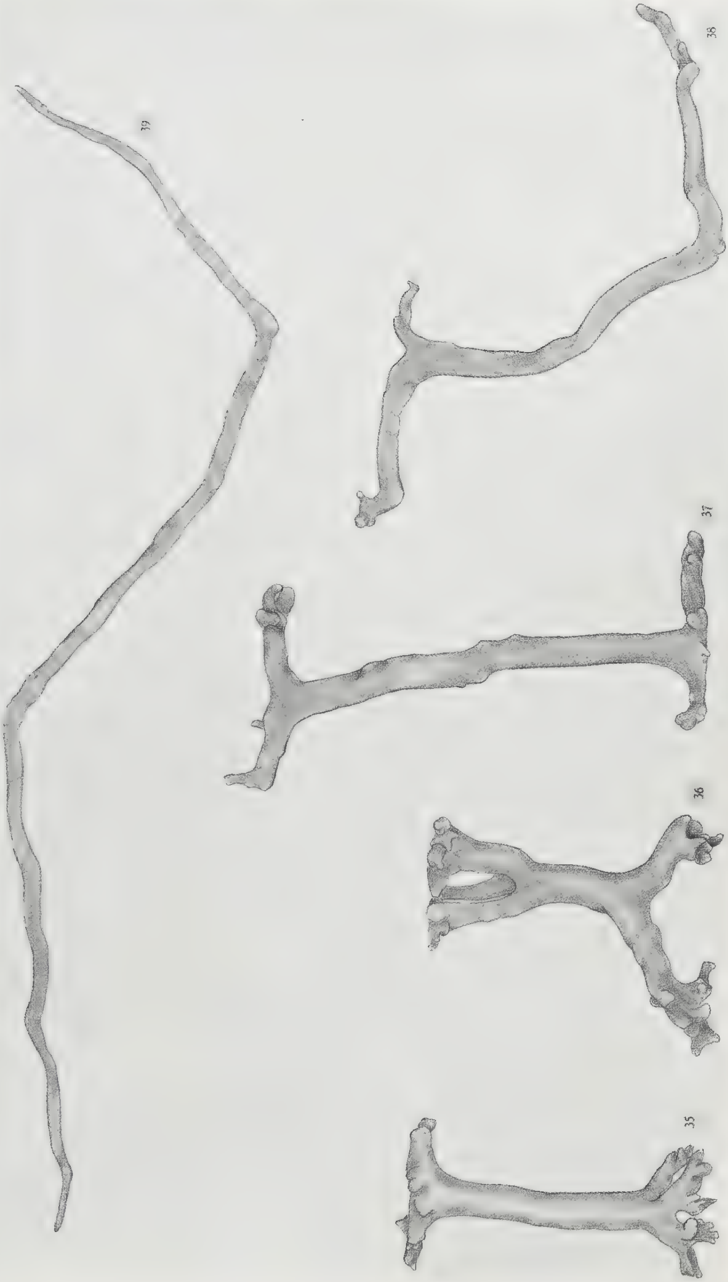


FOLIAR SCLEREIDS IN MOURIRIA

same leaf shown in *fig. 22*, illustrating the overlapping of the subepidermal ends of the sclereids. Fig. 24. *M. crassifolia* Sagot, *Utrecht Herb. 3358*. Adaxial surface of the lamina showing the tangled overlapping subepidermal portions of the filiform sclereids.

Plate VIII

Cleared leaves illustrating sclereids of Type IV. Magnification × 140. Fig. 25. *M. eugeniaefolia* Spruce, *Spruce*, Dec.–Mar. 1850. Margin of lamina showing the tangled arrangement of the filiform sclereids. Note the extremely slender acuminate free tips of certain sclereids. Fig. 26. *M. densifoliata* Ducke, *Ducke 801*. Adaxial surface of the lamina showing the acuminate unbranched subepidermal ends of the sclereids. Fig. 27. Abaxial surface of a portion of the same leaf shown in *fig. 26*. Note the numerous stomatal crypts (circular structures) and the subepidermal crowded branches of the sclereids.

Plate IX

Cleared leaves illustrating sclereids of Type IV. Magnification × 140. Fig. 28. *M. Apiranga* Spruce, *da Costa 124*. Abaxial surface of lamina showing intertwined subepidermal portions of the very slender filiform sclereids. Fig. 29. *M. arborea* Gardn., *Gardner 5704*. Adaxial surface of lamina showing profuse branching of fiber-like sclereids beneath the epidermis. Fig. 30. *M. Petroniana* Cogn. & Sald., *Glaziou 13860*. Abaxial surface of lamina showing the branching of the fiber-like sclereids within the mesophyll and beneath the epidermis.

Plate X

Cleared leaves of *M. maestralis* Urban, *Ekman 9350*, illustrating terminal cells intermediate in form and structure between sclereids and tracheary elements. Magnification × 285. Fig. 31. Two irregularly lobed cells with helical thickenings. Fig. 32. Contrasted forms of "hybrid cells" at the dichotomous ends of a veinlet. Note especially the armed, sclereid-like shape of the lower terminal cell. Fig. 33. The curved end of the veinlet in the center of the figure bears a thin-walled irregularly lobed sclereid-like cell provided with numerous small pits. Below this element is seen a cylindrical tracheid-like cell with prominent helical thickenings attached to a short lateral extension of the veinlet. Fig. 34. A series of veinlets illustrating the diversity of terminal cells typical of this collection of *M. maestralis*. Beginning at the top of the figure the veinlets terminate in (1) a thin-walled radiately branched sclereid-like element, (2) a group of short helically thickened tracheary elements, (3) a small lobed "transitional cell" with helical thickenings, and (4) a typical thick-walled ramified sclereid with conspicuous pits and a very narrow lumen.

Plate XI

Camera-lucida drawings of sclereids isolated by maceration. In order to emphasize the three-dimensional character of these cells, the narrow lumen has been omitted in the drawings. Magnification × 180. Figs. 35 and 36. Columnar branched sclereids of *M. cauliflora* DC., *Ducke 25517*. Fig. 37. Columnar I-shaped sclereid of *M. Pusa* Gardn., *Gardner 2596*. Fig. 38. Branched, fiber-like sclereid of *M. densifoliata* Ducke, *Ducke 801*. Fig. 39. Long unbranched filiform sclereid of *M. crassifolia* Sagot, *Utrecht Herb. 3358*.

University of California,
Berkeley.

PAPUODENDRON, A NEW GENUS OF ARBORESCENT MALVACEAE FROM NEW GUINEA

C. T. WHITE

With one plate

IN JULY and August, 1944, accompanied by Dr. H. E. Dadswell, I spent six weeks in the Mandated Territory of New Guinea conducting a school in forest botany and wood technology for the Forest Survey Companies of the 1st Aust. C. R. E. New Guinea Forests. A number of specimens were collected, and after our departure this work was continued by officers of the survey companies. In many cases no collector's name accompanied the specimens, but all bore numbers preceded by the initials N. G. F. (New Guinea Forests).

It is strange that this new genus was discovered in country previously considered to be fairly well worked over. As attention was concentrated on the big trees, however, other novelties will no doubt be found in the collections. This paper is communicated to the Arnold Arboretum, as so much on Papuan botany of recent years has appeared in its Journal. All cited specimens except that of Clemens are deposited in the Queensland Herbarium, Brisbane; duplicates are in the herbarium of the Arnold Arboretum.

Papuodendron gen. nov.

Epicalyx late campanulatus prominenter 5-dentatus, extus uti calyx petala ovariumque dense lepidotus. Calyx campanulatus epicalyce duplo vel triplo longior, initio ut videtur clausus, demum ad medium in lobos 5 ovatos margine saepe incurvos divisus. Petala 5 imbricata mox decidua. Stamina monadelpha; columna annulo pilorum petala aequante cincta; tubus brevis apice in filamenta ca. 20 divisus, filamentis tubo vix brevioribus, antheris anguste reniformibus rima longitudinali dehiscentibus. Ovarium sessile 5-loculare, loculis pauciovulatis, stylo in ramos 5 stigmatiferos diviso; stigmata majuscula carnosula suborbicularia. Capsula ovoidea, seminibus reniformibus pilis longis densis obsitis.

Arbor. Folia alterna, simplicia, petiolata, penninervia, utrinque lepidota. Flores pro familia parvi, ebracteolati, in paniculos (vel thyrsos) terminales et axillares dispositi.

Species 1 in Papua crescens.

Papuodendron lepidotum sp. nov.

Arbor magna ad 45 m. alta, trunco basin versus anteridifero, cortice griseo, longitudinaliter sulcato, ramulis cortice rubro obtectis, juvenilibus dense lepidotis deinde glabris. Folia elongato-ovata, apice acuta, basi subcordata, utrinque plus vel minus dense lepidota sed lepidibus distinctis margine integris; nervis praecipuis ca. 10 in utroque latere, supra prominulis subtus elevatis; petiolo 1.5 cm. longo, laminis 11–17 cm. longis,

4.5–6.5 cm. latis. Paniculae terminales et in axillis superioribus dispositae, foliis ca. triplo breviores. Epicalyx cum pedicello 2 mm. longo 4 mm. longus. Petala oblonga, 3 mm. longa, intus glabra, extus stellato- vel lepidoto-pubescentia, mox decidua. Annulus pilorum alborum inter petala et tubum stamineum petala aequans. Columna staminea brevis. Capsula dense lepidota, 2 cm. longa. Semina margine pilis albis vel fulvis longis obsita.

New Guinea (North Coast): Narakapoor Road near Yalu, in rain-forest, Forest Survey Company No. 2 *N. G. F. 255* (fl. buds), July 1944 (large tree 120 ft., buttressed up to 6 ft., bark light gray-brown, ½ inch thick, decorticating in small papery flakes); Yalu, in rain-forests on flats, J. Cavanagh *N. G. F. 864* (tree 70 ft., fluted up to 15 ft., crown sparse, leaves insect-eaten, bark fibrous in layers, wood white, light, soft to cut); Aiyura, alt. 6000 ft., L. S. Smith *N. G. F. 1053* (tree 130 ft., buttressed and channelled up to 8 ft., bark ½–⅝ in. thick or slightly more, fibrous, layered, the layers peeling in fibrous strips, wood whitish, fairly soft with conspicuous ripple marks; native name: *Iwo*); Lae, in rain-forest near sea-level, Dadswell, Smith, & White *N. G. F. 1693* (type: flowers and young capsules), July 1944 (tree 140 ft., 90 ft. clear bole, buttressed and channelled up to 10 ft., bark grayish, longitudinally fissured, shed in soft, crumbly flakes, wood whitish, sapwood not defined); Boana,* *Clemens 41728*, May–Nov. 1940, alt. 750–1350 m. (tall tree, ± 65 cm. diameter; flowers dark wine-color).

The nearest affinity with the present genus seems to be *Camptostemon* Masters, but from the description of this given by R. C. Bakhuizen van den Brink in his "Revisio Bombacacearum" (Bull. Jard. Bot. Buitenz. III. 6: 161–232. 1924) the two genera can be distinguished as follows:

Epicalyx irregularly sinuate; calyx irregularly 3-lobed; petals persistent, connate at the base to the staminal tube.....*Camptostemon.*
Epicalyx 5-dentate; calyx equally 5-lobed; petals deciduous, free from the staminal tube.....*Papuodendron.*

Bakhuizen, l. c., mentions the doubtful position of *Camptostemon* and suggests that it may belong to the Hibisceae rather than the Bombacaceae, but I think that the staminal column, antheriferous at the top, places it definitely in the latter group. Apart from this character, the differences between the two groups are not very marked, and in my opinion the Bombacaceae is better retained as a tribe of the Malvaceae than accepted as a distinct family.

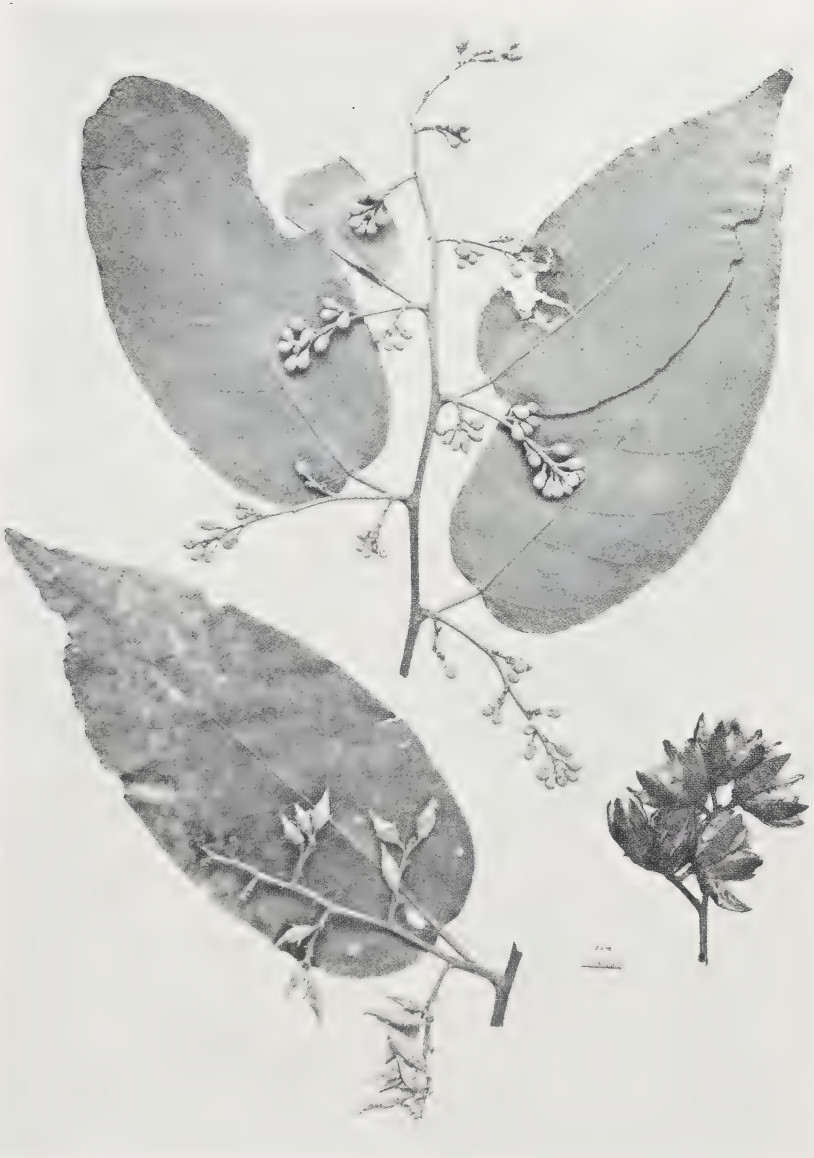
Dr. H. E. Dadswell, who has examined the wood of this new species, states in a letter to me that "*Papuodendron*, from the wood structure point of view, fits the tribe Hibisceae rather than the tribe Durioneae. All the genera listed in the Durioneae in Edlin's classification of the Bombacaceae that we have in our collection or that we can get information on have a special anatomical feature in the medullary rays called 'tile cells.' These tile cells do not occur in the members of the tribe Hibisceae and do not occur in *Papuodendron*. Unfortunately, we do not have specimens of *Camptostemon* to make comparisons. It would be very interesting to see whether tile cells occur in this genus."

* Specimen in the herbarium of the Arnold Arboretum, duplicate in the herbarium of the University of Michigan.

EXPLANATION OF THE PLATE

Papuodendron lepidotum. Top, branchlet bearing inflorescences with flower-buds (from type collection). Bottom left, branchlet with very young fruits (from type collection). Bottom right, dehiscing fruits (from *N. G. F. 1053*, from Aiyura).

QUEENSLAND HERBARIUM,
BOTANIC GARDENS,
BRISBANE, AUSTRALIA.



Papuodendron lepidotum C. T. White

NOTES ON PAPUASIAN SAXIFRAGACEAE*

JOHN R. REEDER

With one text-figure

THE ONLY comprehensive treatment of the Papuasian Saxifragaceae is that by R. Schlechter (in Bot. Jahrb. 52: 118–138. 1914), in which he recognized seven genera and 25 species in the group. Only a few new species have been described since 1914. In the present paper 11 new species are described, of which three are in the genus *Carpodetus*, two in *Quintinia*, and six in *Polyosma*. Engler's treatment (in Nat. Pfl. ed. 2. 18a: 74–226. 1930) may be consulted for the relationships of the Papuasian genera.

In connection with this study, herbarium specimens have been seen from the Arnold Arboretum (A), the Gray Herbarium (GH), the University of Michigan (Mich), the New York Botanical Garden (NY), and the University of California (UC). In the absence of parenthetical letters indicating the place of deposit, cited specimens are to be found only at the Arnold Arboretum. The writer is indebted to the Directors and Curators of institutions from which material has been borrowed, and to staff-members of the Arnold Arboretum, especially to Dr. A. C. Smith, for advice during the progress of this work.

Carpodetus J. R. & G. Forst.

(*Argyrocalymma* K. Schum. & Lauterb.)

Carpodetus amplus sp. nov.

Arbor 6–7 m. alta, ramulis juventute teretibus circiter 4–5 mm. diametro, sparsim puberulis demum glabratis; petiolis supra canaliculatis substrigosis decurrentibus circiter 1 mm. longis; laminis chartaceis in sicco fusco-olivaceis ellipticis vel oblongis, majoribus 10–14 cm. longis 4–10 cm. latis, supra glabris, subtus pilis 0.3–0.5 mm. longis sparsim nervis densius adpresso-strigosis, basi inaequaliter rotundatis, in apicem 1–1.5 cm. longum subabrupte angustatis, margine conspicue serrato-mucronatis, obvie revolutis, costa supra impressa subtus valde prominente, nervis lateralibus utrinsecus circiter 6 vel 7 supra impressis subtus prominentibus, venulis supra leviter subtus valde prominulis; inflorescentia corymboso-paniculata ampla terminali sub fructu circiter 15 cm. longa et 23 cm. lata e basi 3- vel 4-divisa, plerumque 5- vel 6-plo di- vel trichotoma, pedunculis secundariis 3.5–6 cm. longis inferne teretibus superne complanatis, ramis inflorescentiae pedicellisque pallido-puberulis, ramulis ultimis gracillimis; pedicellis teretibus circiter 1.5 mm. longis; fructibus subglobosis submaturis ad 6 mm. diametro rugulosis sparsim puberulis, supra medium calycis lobis

* Botanical Results of the Richard Archbold Expeditions.

4 deltoideo-lanceolatis 0.3–0.5 mm. longis ornatis, apice stylo conico-subulato circiter 1.5 mm. longo coronatis.

SOLOMON ISLANDS: Guadalcanal: Ululolo, Tutuve Mt., alt. 1200 m., *Kajewski 2599* (TYPE), April 29, 1931 (small tree 6–7 m. high, common in rain-forest; fruit on terminal panicles).

Carpodetus amplus is of the alliance of *C. arboreus* (Lauterb. & K. Schum.) Schlechter. These two species are the only ones in the genus which have thus far been described as being 4-merous. From *C. arboreus* the new species differs in having somewhat larger leaves, which are absolutely glabrous on the upper surface, only slightly appressed-strigose beneath, and with a short-attenuate tip. A further difference is that *C. amplus* has a more diffuse inflorescence, which is about one-third larger than that of its ally. Since the Kajewski specimen is in fruit, no comparison can be made with regard to characters of the flowers.

The discovery of this new species extends the range of the genus to the Solomon Islands.

Carpodetus major Schlechter in Bot. Jahrb. 52: 137. *fig. 6.* 1914.

NORTHEAST NEW GUINEA: Finisterre Mountains, alt. 1300 m., *Schlechter 18186* (UC, TYPE COLL.), Sept. 1908 (tree, in misty forest); Morobe District, Kaile to Sarawaket, alt. 1566 m., *Clemens 4791* (small shrub or tree on open trails); Ogeramnang, alt. about 1650 m., *Clemens 5096*, alt. 1500–1800 m., *11211* (A, Mich) (tree 2.5 cm. diam.; flowers white), *11322* (A, Mich) (tree; flower-buds dull, colorless), *41024* (Mich) (small tree on mountain ridge; fruit gray).

The Clemens specimens cited above appear to be identical with the type collection, which apparently has been the only representative of the species thus far cited.

Carpodetus Archboldianus sp. nov.

Frutex vel arbuscula 2–4 m. alta, ramulis juventute subteretibus circiter 2–3 mm. diametro sparsim strigosis, demum glabratis; petiolis supra canaliculatis strigosis decurrentibus circiter 6 mm. longis; laminis chartaceis in sicco viridibus vel fusco-olivaceis ellipticis, (4–) 6–10 cm. longis, (2–) 3–5 cm. latis, utrinque pilis albidis dispersis 0.3–0.5 mm. longis sparsim adpresso-strigosis, basi obtusis, apice plerumque cuspidatis, margine dentibus 8–12 utrinsecus serrato-mucronatis, costa supra impressa subtus valde prominente, nervis lateralibus principalibus utrinsecus circiter 5–7, venulis supra leviter subtus valde prominulis; inflorescentiis corymboso-paniculatis terminalibus multifloris, pedunculo brevi rhachi pedicellisque brunneo-strigosis; pedicellis circiter 2 mm. longis extus sericeis intus glabris; calyce extus breviter sericeo ad 4 mm. longo, tubo cupuliformi 1.5–2.5 mm. longo circiter 2.5 mm. diametro, limbo 5- vel 6-lobato intus glabro, lobis anguste triangularibus 1–1.5 mm. longis; petalis 5 vel 6 patentibus ellipticis circiter 3 × 2 mm., extus sericeis intus basim versus pilosis; staminibus 5 vel 6 circiter 2 mm. longis, filamentis gracilibus distaliter angustatis sparsim pilosis, antheris ovalibus circiter 0.8 mm. diametro; stylo subulato glabro quam staminibus paullo breviore basi circiter 0.4 mm. diametro, stigmate capitato; fructibus subglobosis circiter 8 mm. diametro, calycis lobis et stylo persistente coronatis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m.,

Brass 10583 (TYPE), Oct. 1938 (tree 3 m. high, occasional in forest second growths, flowers cream), *10869* (small tree 2–3 m. high, common in early second growth forests on landslips; flowers white); 18 km. northeast of Lake Habbema, Bele River, alt. 2200 m., *Brass 11080* (shrub or tree 2–3 m. high, abundant in undergrowth of pole-wood secondary forest; flowers cream-colored); Balim River, east of Lake Habbema, alt. 1800 m., *Brass 11768* (tree 2–4 m. high, common in sparse secondary forest; flowers white).

Carpodetus Archboldianus is of the alliance of *C. Pullei* Schlechter, but differs in having both sides of the leaves sparsely covered with short appressed strigose hairs. The nerves and petiole are also sparsely strigose. *Carpodetus Pullei* is described as having leaves which are glabrous above and with the nerves below and the petiole puberulent. A further difference is found in the distinctly eglandular disk and the narrowly triangular to subulate calyx-lobes of the new species. Another species to be considered here is *Carpodetus flexuosus* (Ridley) Reeder, but it is too inadequately described to permit critical comparison. From *C. Archboldianus* this latter species differs in having larger, differently shaped leaves and in minor floral characters.

Carpodetus fuscus sp. nov.

Arbor ad 21 m. alta, ramulis juventute teretibus circiter 3–4 mm. diametro dense fusco-hispidulis demum subglabratis; petiolis canaliculatis dense hispidulis circiter 1 1.5 cm. longis; laminis chartaceis ellipticis vel oblongis, 10–17 cm. longis, 4–7.5 cm. latis, in sicco supra pallido-viridibus et sparsim adpresso-strigosis, subtus fuscis et pilos brunneos 0.3–0.5 mm. longos hispidulos dense gerentibus, basi subinaequaliter rotundatis, in apicem 1–1.5 cm. longum subabrupte angustatis, margine dentibus 3 per centimetrum callosis parvis ornatis, costa et nervis lateralibus utrinsecus circiter 8 supra impressis subtus valde prominentibus, venulis supra immersis vel subimpressis subtus valde prominulis; inflorescentia corymboso-paniculata terminali vel axillari sub fructu circiter 8 cm. longa et 10 cm. lata e basi 2–4-divisa, plerumque 3- vel 4-plo di- vel trichotoma, pedunculis secundariis 3–4 cm. longis, ramis inflorescentiae pedicellisque dense fusco-tomentosis, ramulis ultimis rigidis; pedicellis teretibus circiter 2 mm. longis; fructibus subglobosis submaturis ad 7 mm. diametro rugulosis, supra medium calycis lobis 5 lato-deltoideis circiter 0.8 mm. longis et basi 1.2 mm. latis mox caducis ornatis; petalis sub fructu raro persistentibus anguste triangularibus circiter 3 mm. longis et 1.2 mm. latis, extus brunneo-puberulis intus medio albido-pilosis; stylo mox caducis.

NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass & Versteegh 10468* (TYPE), Oct. 1938 (tree 21 m. high, common in valley forest substage, the trunk 27 cm. diameter; bark 4 mm. thick, gray, fairly smooth; wood white; young fruits brownish green).

Carpodetus fuscus is easily recognized by the dense stiff brown hairs on the young twigs and on the lower surfaces of the leaves. The upper surfaces of the leaves are only slightly hairy. The size and shape of the leaves suggest *C. grandiflorus* Schlechter, but the pubescence is quite different, and the inflorescence of *C. fuscus* is much larger.

Carpodetus denticulatus (Ridley) comb. nov.

Argyrocalymma denticulata Ridley in Trans. Linn. Soc. II. Bot. 9: 39. 1916.

This species is based on a collection by the Wollaston Expedition from the southern slopes of Mt. Carstensz at an altitude of 1180 m.; it appears distinct from others of the genus, although I have not seen any collections which precisely match Ridley's description. In referring species of *Argyrocalymma* to *Carpodetus* I follow the treatments of Schlechter (in Bot. Jahrb. 52: 136. 1914) and Engler (in Nat. Pfl. ed. 2. 18a: 216–217. 1930).

Carpodetus flexuosus (Ridley) comb. nov.

Argyrocalymma flexuosa Ridley in Trans. Linn. Soc. II. Bot. 9: 39. 1916.

This species is based on a collection from the same locality as the above, *C. denticulatus*, and it also appears distinct in the genus.

Carpodetus montanus (Ridley) comb. nov.

Argyrocalymma montana Ridley in Trans. Linn. Soc. II. Bot. 9: 39. 1916.

BRITISH NEW GUINEA: Central Division, Mt. Albert Edward, alt. 3680 m., *Brass 4282* (tree 3 m. tall, common on forest-fringes and in small isolated forest-patches on grasslands; flowers brownish green; fruit green), *4321* (slender tree 5 m. tall, common in isolated forest-patches and fringes of main forest; leaves yellow-green underneath; flowers greenish brown; fruit tuberculate).

The cited specimens are certainly conspecific and agree in general with Ridley's original description, based on a plant from the southern slopes of Mt. Carstensz at 3200 m. altitude. This description is so inadequate that positive identification is impossible, but a few minor differences are apparent. Ridley described the petioles as being 2 mm. long, whereas the Brass specimens have some petioles up to 5 mm. long. Whereas Ridley described the inflorescences as "dense hirtae," those of the Brass specimens are rather sericeous. Ridley stated that the leaves are 1.5–2 cm. wide, while an occasional leaf on the Brass specimens may be up to 2.8 cm. wide. In all other respects the specimens seem to agree with the original description.

Quintinia A. DC.

(*Dedea* Baill.)

Quintinia Ledermannii Schlechter in Bot. Jahrb. 52: 125. *fig. 3.* 1914.

NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 900 m., *Brass & Versteegh 13132* (tree 21 m. high, the trunk 45 cm. diam.; bark 14 mm. thick, gray, shallowly fissured; wood red-brown; flower-buds light green; common in *Agathis* forest, on slope of a ridge), *Brass 13703* (tree 20–25 m. high, abundant in *Agathis* forest as a subsidiary tree; flowers white).

The cited specimens are certainly conspecific and agree very well with the original description, based on *Ledermann 9056* and *10167* from Northeast New Guinea at 850 m. and 1000 m. respectively. Ledermann's specimens were collected on the Etappenberg and Lordberg Mountains near the Sepik River, which is reasonably close to the Netherlands New Guinea locality.

Quintinia lanceolata sp. nov.

Arbor ad 32 m. alta, dense foliata, ramulis infra petiolum leviter

angulatis circiter 4–5 mm. diametro; petiolis canaliculatis 1–1.5 cm. longis; laminis subcoriaceis lanceolatis, (4–) 6–9 cm. longis, (1–) 1.5–2.2 cm. latis, in sicco supra fuscis subtus pallidioribus, basi cuneatis et in petiolum angustatis, apice obtusis vel acutis, margine integris et minute revolutis, costa supra impressa subtus valde prominente, nervis lateralibus principalibus utrinsecus circiter 6 vel 7 supra immersis subtus haud prominulis; racemis lateralibus ad 6.5 cm. longis 25–30-floris quam foliis paullo brevioribus, pedicellis 2–2.5 mm. longis; calyce circiter 1.5 mm. longo, tubo obconico circiter 1 mm. longo et 1.5 mm. diametro, limbo 4-dentato, dentibus apiculatis; petalis 4 uninervatis oblongis circiter 2 × 1 mm. apice obtusis; staminibus 4 circiter 1.2 mm. longis, filamentis ovatis circiter 0.5 × 0.4 mm., antheris subsagittatis in flore femineo ut videtur sterilibus; stylo quam staminibus paullo longiore circiter 0.5 mm. diametro, stigmate 4-capitato, ovario 4-loculari, placentis axillaribus.

Netherlands New Guinea: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1770 m., *Brass & Versteegh 11920* (type), Jan. 1939 (tree 32 m. high, occasional in mossy forest; flowers white; young fruits green).

Quintinia lanceolata is of the alliance of *Q. Ledermannii* Schlechter, of Northeast New Guinea, collected at somewhat lower altitudes, from which it differs in having narrower leaves of thicker texture and with very obscure venation, longer racemes, shorter calyx-teeth, and petals with only one nerve.

Quintinia Macgregorii F. v. Muell. in Vict. Nat. 9: 112. 1892. Fig. 1, D–F.

British New Guinea: Central Division, Murray Pass, Wharton Range, alt. 2840 m., *Brass 4719* (A, NY) (tree 6 m. tall, rare in open low forest, densely branching; leaves lepidote above, the veins conspicuous on the lower surface).

This species was described very superficially. Mueller states merely, "This occurs high up on Mt. Suckling, and is nearest to *Q. Fawkneri*, but

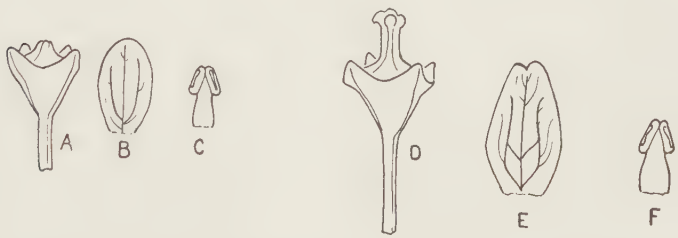


Fig. 1. A–C. *Quintinia Brassii*; A. flower with petals and stamens removed; B. petal; C. stamen. D–F. *Quintinia Macgregorii*; D. flower with petals and stamens removed; E. petal; F. stamen. All approximately × 5.

the leaves are larger and on much longer stalks, the calyces are less angular, the style is much shorter, and the fruit-valves are more emersed." The Brass specimen cited above was collected at a similar altitude and seems to differ from *Q. Fawkneri* in about the same particulars as are given in the description of *Q. Macgregorii*.

The following material of *Q. Fawkneri* F. v. Muell. is available: AUSTRALIA: Queensland: Rockingham Bay, *Herb. F. v. Mueller* (coll. *Dallachy*?, prob. TYPE COLL., GH); Bellenden Ker, *C. T. White*; Mt. Spurgeon, *C. T. White 10599* (very common climber on trees and over rocks in rain-forest; leaves markedly dimorphic, at first small and rounded, those on flowering branches oblong, cuneate; flowers white); Mt. Bartle Frere, alt. 1500 m., *Kajewski 1275* (small tree up to 10 m. high, sometimes adopting a procumbent habit, rooting and climbing over rocks; petals white and very showy).

Quintinia Brassii sp. nov. FIG. 1, A–C.

Arbor 10–12 m. alta, ramulis infra petiolum leviter angulatis circiter 4–5 mm. diametro; petiolis canaliculatis 1–1.5 cm. longis; laminis subcoriaceis elliptico-oblanceolatis, (4–) 6–9 cm. longis, 1.5–2.5 cm. latis, in sicco supra fusco-viridibus, subtus pallidioribus, basi cuneatis et in petiolum angustatis, apice obtusis vel acutis, margine integris et minute revolutis, costa supra impressa subtus valde prominente, nervis lateralibus principalibus utrinsecus circiter 12 utrinque prominulis vel supra interdum immersis marginem versus anastomosantibus; racemo florifero incompleto solo viso, pedicellis circiter 2 mm. longis; floribus 4- vel 5-meris, calycis tubo obconico circiter 1 mm. longo et 1 mm. diametro, calycis lobis deltoideis circiter 0.7 mm. longis; petalis ellipticis circiter 2.5 × 1.5 mm., nervis principalibus circiter 3 prominentibus; staminibus circiter 1.2 mm. longis, filamentis oblongis circiter 0.5 × 0.4 mm., antheris subsagittatis in flore femineo ut videtur sterilibus; stylo quam staminibus paullo breviore circiter 0.5 mm. diametro, stigmate 4-capitato, ovario 1-loculari, placentis axillaribus; racemis fructiferis ad 9 cm. longis, fructibus circiter 25–30 cupuliformibus, parte basali circiter 2 × 2 mm. conspicue 10-costata, parte distali ovarii quam calycis lobis duplo longiore aperte dehiscente, valvis stigmatibus persistentibus coronatis.

NETHERLANDS NEW GUINEA: 6 km. northeast of Lake Habbema, alt. 3200 m., *Brass 11007* (TYPE), Oct. 1938 (tree 10–12 m. high, abundant in mossy forest on the mountain-slopes; foliage gray).

Quintinia Brassii differs but slightly in foliage from *Q. Macgregorii* F. v. Muell., from Mt. Suckling, British New Guinea, the leaves being slightly longer and narrower. The twigs of the new species are definitely angled and gray, while those of *Q. Macgregorii* are terete and reddish brown. The flowers of *Q. Brassii* are about one-half as large as those of its ally, with extremely short styles and petals with rounded rather than emarginate tips.

Quintinia Schlechteriana O. C. Schmidt in Nova Guin. Bot. 14: 148. 1924.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2350 m., *Brass 11453* (shrub 1 m. high, in shrubby regrowth in a forest clearing; leaves pale underneath, the margins recurved; flowers white).

The cited specimen agrees in general with the original description of *Q. Schlechteriana*, based on specimens from the nearby Doormantop at similar elevations. Schmidt describes the petioles as being pubescent. The petioles of the Brass specimen are hardly pubescent, but they are covered with peltate scales; these, however, are not confined to the petioles but cover the young twigs as well. Another difference is that the Brass specimen has pedicels up to 4 mm. long while the description states "± 2

mm." Schmidt describes *Q. Schlechteriana* as having calyx-segments "1.8 mm. long." Those of the Brass specimen are only 0.8 mm. Since the proportions of the flower are essentially the same in other respects, this is probably a misprint. The type specimen not being available for direct comparison, I do not feel justified in proposing a new species on the basis of these minor variations.

Quintinia epiphytica Mattf. in Bot. Jahrb. 70: 469. 1940.

Northeast New Guinea: Morobe District, Yunzaing, Mt. Aloki forest, alt. 1200–1500 m., *Clemens 2379* (vine; petals and anthers white); A-mieng (A-mien), on Yaneng (Yanem) River, a tributary of the Buso River, above mouth of Tasapik Creek, alt. 1500–1800 m., *Clemens 12368* (flowers white; fruits dull greenish). Netherlands New Guinea: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13453* (epiphytic shrub 1 m. high; flowers white).

The cited specimens seem certainly to be conspecific and agree very well with the original description, based on *Clemens 7168* and *5845*, from Sambanga and Sarawaket, localities of similar altitude and in the general vicinity of those cited above from Northeast New Guinea. The Brass specimen is from a slightly lower altitude. All of the cited specimens are either epiphytic shrubs or vine-like plants. The original description states: "frutex epiphyticus," but Mattfeld says that a note with the type specimen reads: "common scandent shrub on largest trees in mossy bush." Although the cited specimens have some leaves which are slightly broader, they agree with the original description in most particulars.

Quintinia altigena Schlechter in Bot. Jahrb. 52: 127. 1914, in Nova Guin. Bot. 12: 488. 1917.

Netherlands New Guinea: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass & Versteegh 10449* (tree 24 m. high, rare in mossy forest; crown dark, not wide-spreading; flowers white; young fruits green); 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 11856* (tree 15-20 m. high, one of the commonest subsidiary trees; underside of leaves very pale; flowers white), *Brass & Versteegh 11983* (tree 19 m. high, common on slopes of a ridge; flowers white); 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2100 m., *Brass 12194* (tree 3–5 m. high, abundant in stunted mossy forest on an exposed summit; leaves very pale beneath; flowers white).

The cited specimens appear to be conspecific and probably represent *Q. altigena* Schlechter, the type of which was collected on open terrain of the Hubrecht Mountains, Northeast New Guinea. The Brass specimens may be confidently excluded from all other species of *Quintinia* except *Q. altigena*, the original description of which is too generalized to permit absolute identification. The leaves of Schlechter's species are said to be 7–9.5 cm. long including the petiole, which is described as being 1 cm. long. The Brass specimens have leaves up to 12 cm. long and petioles as much as 2 cm. long. In addition, these leaves may be up to 5 cm. wide, while those of *Q. altigena* are described as being 2–3 cm. wide. On *Brass & Versteegh 10449*, however, which most closely agrees with the description, the leaves average about 9 cm. long and about 2.5–3 cm. broad, the petioles also are only slightly more than 1 cm. long. This last-cited specimen was collected at a comparatively high elevation (2800 m.), which

is nearer to that of the type (3100 m.). It seems possible that the other specimens may well represent more robust forms of the same species growing at lower elevations. In spite of variation in leaves and other minor differences among the specimens cited, I am confident that only one species of reasonable variability is represented.

Polyosma Blume

In his discussion of *Polyosma*, Schlechter (in Bot. Jahrb. 52: 127–136. 1914) includes a key in which the main divisions are based on whether the corolla is tubular or split into separate petals. While these divisions may appear to be rather arbitrary, the present study has shown that the character is reliable. In those species in which the corollas split into separate petals, longitudinal lines are evident early in the bud; in those corollas which remain tubular, however, no lines appear even at maturity.

Polyosma mucronata sp. nov.

Frutex ad 50 cm. altus, ramulis juventute subteretibus circiter 2–3 mm. diametro, dense sericeis, demum glabratis; petiolis supra canaliculatis 1.5–3 cm. longis; laminis coriaceis in sicco fusco-olivaceis obovatis vel elliptico-obovatis, (2–) 3.5–5 cm. longis, (1.5–) 2–2.5 cm. latis, supra nitidis, subtus pallidis, basi acutis vel attenuatis et in petiolum angustatis, apice rotundatis mucronatis, margine minute revolutis, costa supra impressa subtus prominente, nervis lateralibus utrinsecus 6–10 supra inconspicue prominulis subtus leviter elevatis marginem versus anastomosantibus, venulis immersis; racemis terminalibus ad 8 cm. longis 12–16-floris, pedunculo brevi rhachi pedicellisque dense sericeis; pedicellis ad 3 mm. longis, bracteola apicali trifida extus sericea intus glabra, segmento centrali late ovato 2.5–3 mm. longo circiter 1 mm. lato, segmentis lateralibus aequalibus anguste ovatis 2.3–2.5 mm. longis 0.6 mm. latis; calyce extus sericeo circiter 4 mm. longo, tubo obconico-urceolato circiter 2 mm. longo et 1.6 mm. diametro, limbo 4-lobato intus glabro, lobis suberectis deltoideis circiter 1.2 mm. longis; corolla cylindrica maturitate circiter 14 mm. longa et 2.5 mm. diametro extus dense sericea intus glabra 4-lobata, lobis subcarnosis late ovatis circiter 2 × 1.8 mm. apice obtusis; staminibus 4 circiter 11 mm. longis, filamentis complanatis circiter 0.5 mm. latis copiose pilosis, pilis adscendentibus ad 0.8 mm. longis, antheris circiter 1.8 mm. longis, connectivo latitudine filamentum aequante; stylo tereti quam staminibus paullo longiore 0.5–0.6 mm. diametro dense et breviter hispidulo, stigmate capitato, placentis parietalibus; fructibus ellipsoideis circiter 14 × 11 mm. (ex. coll.) basi et apice obtusis.

BRITISH NEW GUINEA: Central Division, Mt. Albert Edward, alt. 3600 m., *Brass 4310* (A, TYPE, NY), June 23, 1933 (sparsely branched shrub of erect habit, up to 50 cm. high, gregarious on forest-floor, not found above 3600 m.; branches and petioles dark purple; flowers pale purple-gray, very fragrant; fruit smooth, fleshy, dark purple).

Polyosma mucronata is of the alliance of *P. stenosiphon* Schlechter, from the Schraderberg Mountains of Northeast New Guinea, from which it differs in having much longer petioles, somewhat broader leaf-blades,

longer calyx-teeth, more copiously pilose filaments, and a conspicuously pubescent style.

Polyosma amygdaloides sp. nov.

Arbor ad 12 m. alta, ramis ramulisque subteretibus, ramulis juvenilibus circiter 2.5 mm. diametro primo leviter puberulis mox subglabratis; petiolis canaliculatis rugulosis 1.3–2.5 cm. longis; laminis coriaceis in sicco viridifuscis subtus pallidioribus lanceolatis, (5–) 8–17 cm. longis, (1.6–) 2.5–4.2 cm. latis, utrinque glabris, supra nitidis, basi cuneatis vel attenuatis, apice in acuminem 1–2 cm. longum gradatim attenuatis, margine subintegris vel dentes paucos callosos distanter gerentibus, costa supra impressa subtus prominente, nervis lateralibus utrinsecus 8–13 patentibus obvie anastomosantibus utrinque prominulis, rete venularum utrinque subimmerso; racemis terminalibus vel subterminalibus ad 15 cm. longis multifloris (floribus plerumque 100–150), rhachi pedicellisque sericeis; pedicellis ad 3.5 mm. longis, bracteola apicali trifida extus sericea intus glabra, segmento centrali ovato-attenuato circiter 1 mm. longo et basi 0.5 mm. lato, segmentis lateralibus aequalibus anguste ovatis 0.6–0.7 mm. longis, circiter 0.2 mm. latis; calyce extus sericeo, circiter 2.5 mm. longo, tubo obconico-urceolato 1.75–2 mm. longo 1.2–1.4 mm. diam., limbo 4-dentato, dentibus apiculatis circiter 0.5 mm. longis; corolla cylindrica maturitate circiter 15 mm. longa et 1.5–2 mm. diametro, extus dense sericea, intus copiose farinoso-puberula, lobis subcarnosis oblongo-ovatis circiter 3 × 1 mm. apice obtusis; staminibus circiter 13 mm. longis, filamentis complanatis sparse pilosis, antheris 2–2.5 mm. longis, connectivo latitudine filamentum aequante; stylo tereti quam staminibus paullo longiore 0.4–0.5 mm. diametro strigoso, stigmate capitato, placentis parietalibus; fructibus subglobosis circiter 6 mm. diametro, basi obtusis, apice umbonatis.

Netherlands New Guinea: Bernhard Camp, Idenburg River, alt. 900 m., *Brass 13335* (type), March 1939 (substage tree 12 m. high, occasional in rain-forest on the slopes; flowers yellow, fragrant).

The new species, characterized by lanceolate long-acuminate leaf-blades and very abundant flowers, appears to have no close relatives. In some respects it suggests *P. buxea* Mattf. (of which a type duplicate is available at A), but it differs in its darker differently shaped leaf-blades, obviously pedicellate rather than subsessile flowers, and much longer corollas.

Polyosma cestroides Schlechter in Bot. Jahrb. 52: 129. *fig. 4, A–F.* 1914.

Northeast New Guinea: Morobe District, Yunzaing, alt. about 1650 m., *Clemens 3744* (tree, the trunk 10–13 cm. diameter; flowers flesh-colored to salmon; fruit blue-purple [not seen on our specimen]).

The cited specimen agrees in most particulars with the original description, based on *Ledermann 12566*, from the Sepik region at a similar elevation. The only differences noted are that in the Clemens specimen the inflorescences are about 25–35-flowered, while the original description states that they are 6–12-flowered. Since Schlechter based his description on only one collection, I do not believe this difference to be significant. A further difference is in the bracteoles, which in the Clemens specimen are 1.5–2 mm. long. Schlechter describes them as being 4–5 mm. long, but in his illustration he shows no bracteoles at all. This is probably an

error. Since the ovary is only 2 mm. long, and the bracteoles are immediately below it, if these latter structures were 4–5 mm. long they would exceed the ovary and be quite conspicuous. In this case one would expect that special mention of them would be made in the description and that they would be prominently figured in the illustration.

Polyosma tubulosa Schlechter in Bot. Jahrb. 52: 130. *fig. 4, G–L.* 1914.

NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12285* (substage tree 10 m. high, in mossy forest; flowers brownish green).

The cited specimen agrees reasonably well with Schlechter's species, although the leaf-blades are sometimes longer (up to 9 cm.) than those originally described. The Brass specimen has racemes up to 17-flowered, while Schlechter's description states that they are "5–10-floris." His illustration, however, shows a raceme with 17 flowers. In other particulars our specimen agrees well with both the description and illustration.

Polyosma induta sp. nov.

Arbor ad 4 m. alta, ramulis juventute subcomplanatis dense tomentosis, demum glabratis; petiolis supra canaliculatis dense tomentosis 1.3–2.5 cm. longis; laminis in sicco fusco-viridibus ellipticis, 8–15 cm. longis, 2.5–5.5 cm. latis, supra glabris, subtus praecipue nervis tomentosis, basi cuneatis vel attenuatis et in petiolum angustatis, apice acutis vel breviter acuminatis, margine dentibus utrinsecus 5–7 distanter calloso-serratis, costa supra impressa subtus prominente, nervis lateralibus utrinsecus 8–12 supra prominulis subtus valde elevatis marginem versus anastomosantibus, venulis supra immersis subtus elevatis; racemis terminalibus ad 10 cm. longis dense 30–45-floris, pedunculo brevi rhachi pedicellisque dense tomentosis; pedicellis 4–8 mm. longis, bracteola apicali trifida extus tomentosa intus glabra vel sparsim pilosa, segmento centrali lanceolato 3–3.5 mm. longo 0.5–0.8 mm. lato, segmentis lateralibus aequalibus lanceolatis circiter 2.5 mm. longis et 0.4 mm. latis; calyce extus sericeo-tomentello circiter 3 mm. longo, tubo obconico-urceolato circiter 2 mm. longo et 2–2.5 mm. diametro, limbo 4-dentato, dentibus apiculatis; corolla cylindrica maturitate circiter 17–20 mm. longa et 1.5–2 mm. diametro, extus dense sericea intus subglabra, lobis subcarnosis oblongo-ovatis circiter 3 × 1 mm., apice obtusis; staminibus 4 circiter 15–18 mm. longis, filamentis complanatis circiter 0.5 mm. latis sparsim pilosis, antheris 2.5–3 mm. longis, connectivo latitudine filamentum aequante; stylo tereti quam staminibus paullo longiore 0.5–0.6 mm. diametro sericeo, stigmate capitato, placentis parietalibus; fructibus subglobosis 6–9 mm. diametro, bracteola conspicua persistente subtentis, calycis dentibus minutis persistentibus coronatis.

NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2350 m., *Brass 11483* (TYPE), Nov. 1938 (tree 4 m. high, in forest undergrowth; flowers purplish brown).

This species and the following (*P. vochysioides*) are very similar in foliage but differ markedly in characters pertaining to the inflorescence. They appear to have no close relatives, forming an isolated group in the general vicinity of *P. buxea* Mattf., *P. cestroides* Schlechter, etc., from

which the copious pubescence separates them. *Polyosma induta* may also be compared to *P. dentata* Schlechter, from which it differs not only in its persistently tubular corolla, but also in its more pronounced indument, much longer petioles, pedicels, and corollas, and more copiously flowered inflorescences.

Polyosma vochysioides sp. nov.

Arbor 8–10 m. alta, ramulis juventute subcomplanatis dense tomentosis, demum glabratis; petiolis subteretibus dense tomentosis 1–2 cm. longis; laminis in sicco viridi-olivaceis ellipticis, (5–) 7–13 cm. longis, (2–) 3–5.5 cm. latis, supra nitidis mox glabratis, subtus praecipue nervis tomentosis, basi cuneatis, apice in acuminem 1–1.5 cm. longum gradatim attenuatis, margine dentibus utrinsecus 4–6 distanter calloso-serratis, costa supra impressa subtus prominente, nervis lateralibus utrinsecus 7–10 supra prominulis subtus elevatis marginem versus anastomosantibus, venulis supra immersis subtus leviter elevatis; racemis axillaribus vel terminalibus ad 15 cm. longis, 35–65-floris, pedunculo brevi rhachi pedicellisque dense tomentosis; pedicellis sub anthesi ad 4 mm. longis, bracteola apicali trifida, lobis aequalibus linearibus ubique tomentosis circiter 3.5 mm. longis; floribus ex apice pedicellorum abrupte obstipis; calyce extus sericeo circiter 3 mm. longo, tubo obconico-urceolato circiter 1.5 mm. longo et diametro, limbo 4-lobato intus glabro, lobis suberectis deltoideis circiter 1 mm. longis; corolla in alabastro cylindrica 1 mm. diametro, extus dense sericea; staminibus 4, filamentis complanatis breviter sericeis; stylo subclavato sericeo, stigmate capitato; fructibus ellipsoideis circiter 7 × 5 mm., bracteola persistente subtentis, calycis limbo coronatis, pedicellis sub fructu ad 10 mm. longis persistenter tomentosis.

Netherlands New Guinea: Bernhard Camp, Idenburg River, alt. 1800 m., *Brass 12090* (type), Jan. 1939 (tree 8–10 m., frequent in mossy forest substage, with flower-buds and unripe fruits).

From *P. induta*, above described, this species differs but slightly in foliage, its leaf-acumen being more attenuate and longer. In inflorescence, however, there are striking differences between the two species. *Polyosma vochysioides* has the bracteole equally cleft into linear lobes which are uniformly tomentose; the bracteoles of *P. induta* have the central lobe the largest and all the lobes are lanceolate and glabrous within. The flowers of *P. vochysioides* are sharply bent at the apices of the pedicels rather than continuing their direction; the calyx-lobes of *P. vochysioides* are distinctly larger, and it is probable that its corollas are shorter, although mature ones are not available.

Polyosma occulta sp. nov.

Arbor parva dense foliata, ramis ramulisque subteretibus, ramulis juventute circiter 2–3 mm. diametro densissime fusco-velutinis; petiolis canaliculatis subvillosis 0.6–1.5 cm. longis; laminis subcoriaceis undulatis in sicco pallido-viridibus ellipticis vel oblongo-ellipticis, (3–) 3.5–5 cm. longis, (1.5–) 2–2.5 cm. latis, supra subglabris vel sparsim puberulis, subtus densius puberulis, nervis subvillosis, basi cuneatis, apice obtusis vel acutis et calloso-apiculatis, margine dentibus 5 vel 6 distanter calloso-serratis, costa supra impressa subtus prominente, nervis lateralibus utrin-

secus 6–10 patentibus supra prominulis subtus prominentibus conspicue anastomosantibus, rete venularum supra subimmerso subtus leviter elevato; racemis subterminalibus immaturis 3–6 cm. longis 8–20-floris, rhachi pedicellisque subvillosis; pedicellis ante anthesin circiter 2 mm. longis, bracteola apicali trilobata foliacea utrinque subsericea supra sparsius, segmento centrali ovato-lanceolato circiter 7 mm. longo et 2.5 mm. lato, segmentis lateralibus subaequalibus lanceolatis circiter 6 mm. longis et 1.8–2 mm. latis; calyce extus dense sericeo circiter 4.5 mm. longo, tubo vasculari circiter 2 mm. longo et 1.5 mm. diametro, limbo 4-lobato, lobis suberectis lato-ovatis 1.3–1.5 mm. longis intus distaliter sparsim sericeis; corolla in alabastro visa cylindrica 2 mm. diametro extus dense sericea; staminibus 4, filamentis complanatis pilosis; stylo subclavato, sericeo, stigmate capitato; fructibus ovoideo-ellipsoideis, circiter 10 × 7 mm., bracteola conspicua persistente subtentis, calycis limbo coronatis, pedicellis sub fructu ad 6 mm. longis persistenter pilosis.

BRITISH NEW GUINEA: Central Division, Wharton Range, Murray Pass, alt. 2840 m., *Brass 4524* (A, NY, TYPE), June–Sept. 1933 (small tree of forest borders, with smooth undulate leaves; flower-buds brown; fruit green).

This remarkably distinct species is at once recognized by its large persistent foliaceous bracteoles, which conspicuously exceed the calyx in length, and by its ovary, which is definitely bilocular proximally. Further differentiating characters are the compact habit, dense foliage, comparatively small leaf-blades, and few-flowered inflorescences. Another species with a conspicuous bracteole is *P. longebracteolata* O. C. Schmidt, but that species has narrower leaf-blades, shorter petioles, shorter pedicels, and a smaller and differently shaped bracteole. *Polyosma helicioides* F. v. Muell. is too inadequately described to permit comparison, but it apparently differs from the new species in its shorter petioles and pedicels; Mueller does not mention the presence of bracteoles.

The specific epithet refers to the fact that the calyces are concealed by the large bracteoles.

Polyosma oligantha sp. nov.

Arbor 25 m. alta inflorescentiis exceptis ubique glabra, ramulis apicem versus subcomplanatis rugosis crassis circiter 5 mm. diametro, nodis tumefactis; petiolis canaliculatis striatis 1–2.3 cm. longis; laminis crasso-coriaceis in sicco fusco-olivaceis ellipticis, 6–10 cm. longis, 3.5–5.5 cm. latis, basi obtusis vel cuneatis, apice obtusis vel rotundatis interdum leviter emarginatis, costa supra impressa subtus valde prominente, nervis lateralibus utrinsecus circiter 10 erecto-patentibus supra prominentibus conspicue anastomosantibus subtus prominulis, rete venularum supra leviter elevato subtus subimmerso; racemis robustis axillaribus vel terminalibus ad 7 cm. longis 5–8-floris, pedunculo circiter 3 cm. longo, rhachi striata; pedicellis sparsim sericeis 2–3 mm. longis, bracteola apicali trifida extus sparsim sericea intus glabra, segmento centrali ovato 2–3 mm. longo circiter 1 mm. lato, segmentis lateralibus subaequalibus ovatis circiter 1 mm. longis et 0.6 mm. latis; calyce extus sparsim sericeo 5–6 mm. longo et 2.5–3 mm. diametro, lobis erecto-patentibus late ovatis circiter 2 mm. longis et 1.5 mm. latis; corolla cylindrica subcarnosa ad 28 mm. longa et 2.5–3 mm. diametro extus sericea intus glabrata; staminibus quam corolla paullo brevioribus,

filamentis complanatis sparsim pilosis, antheris circiter 7 mm. longis, connectivo quam filamentis angustiore; stylo tereti sericeo quam staminibus paullo longiore 0.5–0.75 mm. diametro, stigmate capitato, placentis parietalibus; fructibus ellipsoideis circiter 13 × 11 cm., basi et apice obtusis.

Netherlands New Guinea: Bernhard Camp, Idenburg River, alt. 2000 m., *Brass 12502* (type), Feb. 1939 (tree 25 m. high, rare in rain-forest on slope of a ridge, the trunk 71 cm. diam., the crown fairly wide-spreading, the flowers brown-green, the fruits green, the bark 10 mm. thick, the wood brown).

Polyosma oligantha seems to have no close relatives in New Guinea. It is easily recognized by its thick twigs, thick leaves with entire margins and rounded to emarginate tips, and its very large flowers. Another species with very long corollas is *P. tubulosa* Schlechter, from the Schraderberg Mountains, Northeast New Guinea, but that species has acuminate, narrower leaves and a calyx only about half as long as that of *P. oligantha*.

Polyosma brachyantha Merr. in Philip. Jour. Sci. Bot. 11: 273. 1916.

British New Guinea: Central Division, Dieni, Ononge road, alt. 500 m., *Brass 3899* (slender tree 10 m. tall, in rain-forest; upper surface of leaves shining, the midrib brown; green [immature] fruit about 1 cm. long by 8 mm. diameter). Solomon Islands: Bougainville: Kupei Gold Field, alt. 950 m., *Kajewski 1647* (small tree up to 15 m. high, common in rain-forest; flowers white on long racemes), *1675* (fruit blue-black when ripe).

The cited specimens seem to be conspecific and appear to be identical with *Polyosma brachyantha* Merr., based on specimens from Amboina. Both the isotype (A) of *P. brachyantha* and the flowering specimen cited above have immature flowers, but these are very similar. Both have stamens with densely pilose filaments and a style which is rather sparsely retrorsely pilose. Although Merrill says that the style is glabrous, a critical re-examination of the isotype shows retrorse hairs.

Polyosma macrobotrys Mattf. in Bot. Jahrb. 69: 273. 1938.

Northeast New Guinea: Morobe District, Quembung Mission, alt. 360 m., *Clemens 2138* (small tree 8–10 m. tall; fruit green-white). New Britain: Kirigo, Maisua, alt. 300 m., *Waterhouse 22688* (small tree 1.5–2 m. tall). Solomon Islands: Ysabel: Tiratona, alt. 600 m., *Brass 3211* (slender thin-barked tree; leaves dark dull green; flowers white), *3311* (fruit costate); Guadalcanal: Uulolo, Tutuve Mt., alt. 1200 m., *Kajewski 2556* (tree up to 20 m. high; fruit green when ripe).

The cited specimens appear certainly to be conspecific and to agree in all particulars with Mattfeld's description; furthermore the Clemens specimen is from the type locality. The occurrence of this species in the Solomon Islands extends the range of the genus to the east; otherwise *Polyosma* is known from the Solomons only by *P. brachyantha* Merr., specimens of which are cited in this paper.

It is possible that the New Hanover specimen cited by Lane-Poole (in For. Res. Papua 90. 1925) and White and Frances (in Proc. Roy. Soc. Queensl. 39: 63. 1928) as *P. lagunensis* Merr. actually represents *P. macrobotrys* Mattf.

Polyosma Forbesii Valeton ex Lauterb. in Nova Guin. Bot. 8: 821. 1912.

British New Guinea: Central Division, Koitaki, alt. about 485 m., *Carr 12644*

(NY) (tree about 8 m. tall; buds green), alt. about 450 m., *Carr 12780* (NY) (tree about 16 m. tall; flowers dull grayish violet); Western Division, Wuroi, Oriomo River, *Brass 5767* (A, NY) (large shrub, uncommon on tidal mudbanks in river; leaves stiff, the upper side glossy, the nerves deeply impressed above, prominent; flowers whitish).

The cited specimens appear to be conspecific and to agree well with Valeton's original description, which is based on a collection from Sogeri in southeastern New Guinea. The Brass specimen has pedicels up to 1.5 mm. and petals up to 10 mm. long, but it agrees in all other particulars. The Carr specimens agree almost precisely with Valeton's description.

ARNOLD ARBORETUM,
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NOVELTIES IN AMERICAN EUPHORBIACEAE

Leon Croizat

Material recently received from various sources in North and South America renders it desirable to publish the data included in this paper. Unless otherwise stated, the types of the new species are deposited in the herbarium of the Arnold Arboretum of Harvard University.

Acalypha Linnaeus

Acalypha plicata Muell.-Arg. in DC. Prodr. 15(2): 855. 1866; Pax & Hoffm. in Pflanzenr. 85(IV. 147): 124. 1924.

Acalypha cordifolia Griseb. in Abhandl. Gesellsch. Wiss. Göttingen 19: 60. 1874; op. cit. 24: 59. 1879. Non Hook. 1847.

Acalypha flabellifera Rusby in Mem. Torrey Bot. Club 6: 119. 1896; Pax & Hoffm. in Pflanzenr. 85 (IV. 147): 121. 1924; Lourteig & O'Donell in Gen. Sp. Pl. Argent. 1: 216. *pl. 90*. 1943. Syn. Nov.

In determining *Vargas 1713*, Peru: Depto. Cuzco, I could only conclude that Hoffmann's suggestion that *A. plicata* Muell.-Arg., "Cum *A. flabellifera* comparanda est et verisimiliter eadem," was correct, and accordingly effect the reduction of Rusby's species. It is impossible to separate *Steinbach 8608*, Bolivia: Cochabamba, from the holotype of Mueller-Argoviensis, a photograph of the latter being available. The vigorous juvenile state represented by *Vargas 1713* is likewise fully matched by *Rojas 9221*, Paraguay: Asunción, which indicates that the species extends from Paraguay, northwestern Argentina, and eastern Bolivia to southeastern Peru, this being a normal distribution. *Acalypha lagoensis* Muell.-Arg., a closely related form, is endemic to eastern Brazil, and may be connected with *A. plicata* Muell.-Arg. by intermediates.

In the affinity of *A. plicata* Muell.-Arg. are the northern Peruvian *A. fulva* I. M. Johnst. and *A. cuspidata* Jacq., the latter endemic to the West Indies, Venezuela, Colombia and Ecuador. *Acalypha Sanctae-Martae* Pax & Hoffm. (1924), is identical with the earlier *A. asterifolia* Rusby (1920) from the Atlantic coast of Colombia, but is uncomfortably close to *A. cuspidata* Jacq. The limits of these forms and their inter-relationships are as yet obscure.

Euphorbia Linnaeus

Euphorbia apurimacensis sp. nov.

Arbor parva ad 3–5 m. alta, innovationibus ad lentem puberulis, cicatricosis, cortice pallide brunneo subaurantiaco. Foliis tenuibus ellipticis apice breviter mucronato-acuminatis, basi sensim angustatis in petiolum breve, 5 mm. longum vel minus productis, lamina glabra 3–7 cm. longa, 1–1.5 cm. lata, margine integerrimo ciliolato, venis patentibus gracillimis obscuris. Cyathiis singulis, pedunculo ca. 5 mm. longo fultis.

bracteolis deciduis subtriangularibus ad 4–5 mm. longis, involucro ipso ad lentem puberulo ca. 3 mm. longo, 5 mm. fauce lato, glandulis integris, habitu erectis. Caetera desunt.

PERU: Apurimac: Prov. Abancai, Quebrada de Matara 2000–2800 m., "Xerophytic slopes," *Vargas 2290*.

The nearest ally of this new species is the Ecuadorean and southern Colombian *E. Latazii* H.B.K., from which *E. apurimacensis* is immediately distinguishable because of its very short-petioled leaves, and short peduncled cyathia, the latter being barely half as large as are those of Kunth's species.

Euphorbia refugii sp. nov.

Perennis videtur, cauliculis annuis erectis spithameis totis albo-villosis, radice albicante donatis. Foliis aequa ratione ac caule pubescentibus, infimis alternis paucis, caeterum ad dichotomias oppositis, ovato-rotundatis ad 1 cm. longis, totidemque latis vel minoribus, irregulariter penninerviis, venis utrinque 3–4, petiolulo ca. 1–2 mm. longo, margine subintegris obscureve repandis, stipulis haud obviis. Foliis floralibus vegetativis subsimilibus, minoribus. Cyathio hispido-villoso ca. 1.5 mm. longo latoque, glandulis 4 appendiculatis, appendicibus integris conspicuis, sordide luteis fabrica vix petaloideis, lobis minimis laceratis subtriangularibus, floribus ♂ paucis ad 5, flore ♀ conferte lanoso, stylis 3, quove ad basim partito, semine ovoideo ca. 0.75 mm. longo, testa laete brunnea, grosse foveolato-punctata, arillo pallido, caruncula minima.

TEXAS: Aransas Co., Aransas Refuge, *Cory* (*Tex. Agr. Exp. Sta.*) 49014.

I am much indebted to Dr. Rogers McVaugh of the United States Department of Agriculture for the transmission of this remarkable novelty. Its seed and habit suggest a species of the Subg. *Tithymalus* Boiss. in the vicinity of *E. commutata* Engelm. or *E. peplidion* Engelm., but this impression is immediately dissipated by the pubescence, and the conspicuous, though not truly petaloid appendages to the glands. The cyathium tends to be slightly zygomorphic, the gynophore protruding through a gap in the involucre, which gap appears to take the place of a missing gland. The ♂ flowers are few, and regularly arranged at the base of the gynophore.

This new species apparently belongs in the Sect. *Ipecacuahna* Boiss., but its closest affinities are not yet clear.

Chamaesyce S. F. Gray emend. Croizat

Chamaesyce trancapatae sp. nov.

Repens, caudice ligneo sat robusto descendente, cauliculos plures saepissime habitu rosulatos edente basi lignosos duros, caeterum herbaceos, internodiis pollicaribus vel brevioribus, totis molliter griseo-lanulosis. Foliis basalibus rotundatis subintegris ca. 3 mm. magnis, caeterum obvie anisophyllis rotundato-triangularibus ad 1 cm. longis, 0.5 mm. latis, margine more *C. hirtae* serratis, utraque facie griseo vel albo-lanulosis, petiolulo quam 1 mm. breviore, stipulis interpetiolaribus acutis subintegris, indumenti copia haud obviis. Cyathiis solitariis, ca. 2 mm. longis, 1.5 mm. latis, glandulis 5 plicatis appendice minima integra pallide rosea vel albida, lobis

triangularibus plus minusve inciso-sectis, involucro ad lobos viridulo, ad glandulas pallido, ovario pedicellato hispido-lanoso, stylis brevibus bifidis.

PERU: Apurimac-Cuzco boundary, Curahuasi, Trancapata, 2800 m., "Stony slopes," *Vargas 1257* (TYPE in herb. Univ. Cuzco, fragment in herb. Arnold Arboretum).

This species is certainly not the same as **Chamaesyce boliviana** (Rusby) Croiz. comb. nov. (*Euphorbia boliviana* Rusby in Bull. New York Bot. Gard. 4: 442. 1907) which its author erroneously assimilates to *C. serpens* (H.B.K.) Small by referring *Mandon 1064* to it. *Chamaesyce trancapatae* lacks outstanding diagnostic characters, but young vigorous shoots are nevertheless easily identified on account of their heavy whitish or grayish pubescence, the leaf shape suggesting that of small forms of *C. hirta* (L.) Millsp.

ARNOLD ARBORETUM,
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PLANT COLLECTING IN THE SOLOMON ISLANDS*

S. F. KAJEWSKI

With two text-figures

TO THE EAST of New Guinea lies a very important chain of Islands, known as the Solomons; this archipelago has great affinities with the Papuan mainland. The people of the two regions are of similar races, having many characteristics in common. The vegetation of the Solomons, although similar in general to that of New Guinea, has certain peculiarities suggestive of the islands farther eastward. There is a political boundary within the Solomons, a portion of the group being under English and a portion under Australian administration. This political boundary, at the time of my visit, was very strictly recognized, as the natives were not allowed to cross it and the whites were required to show passports or permits when crossing it. For biological and geographical discussions the political boundary may be ignored, and all the islands extending from Bougainville to the Santa Cruz group may be considered to make up the Solomons.

The geological formation of the Solomons is of a highly volcanic nature, the soil being remarkably fertile, the rainfall heavy, and the vegetation very luxuriant. For the greater part the islands are exceptionally mountainous and rugged. On Bougainville there is a mountain-chain extending down the center of the island and reaching a height of 10,000 feet, while on Guadalcanal the mountains attain 8,000 feet in height. Most of the smaller islands have mountains up to 5,000 feet in height, and very commonly precipitous hills arise directly from the sea.

The plant life of the Solomons can be divided into two primary groups — that of the lowlands and that of the uplands. As there are very extensive plains on many of the islands, one observes a type of lowland vegetation very different from the usual strand vegetation of the Pacific. The huge plains of southern Bougainville offer an example of lowland inland flora.

* The manuscript of this article has been for some time in the possession of Dr. C. T. White, of the Brisbane Botanic Gardens, by whom it was recently forwarded to the Arnold Arboretum for possible publication. In view of the fact that a complete set of Mr. Kajewski's Solomon Islands plants is deposited at the Arnold Arboretum, where they have been studied and published upon by staff-members, publication of this sketch seems highly desirable. A remarkably high percentage of Mr. Kajewski's specimens have proved to represent new species, as he reached areas and altitudes not visited by the few collectors who preceded him in the Solomons. For an account by the same collector of his work in the New Hebrides and Santa Cruz Islands, see Jour. Arnold Arb. 11: 172–180. 1930. — EDS.

BOUGAINVILLE

The first island of the Solomons which I visited, from April to October, 1930, was Bougainville; this is a large land-mass about 120 miles long and up to 35 miles in breadth. It possesses two active volcanoes, one being the highest point of the island at about 10,000 feet elevation. A very large native population is found on Bougainville, and many areas on the west coast have not yet been brought under control. Labor is plentiful and cheap, in comparison with many other Pacific islands. Because of the large population, much of the rain-forest in the thickly settled areas is regrowth forest and consequently not very high. However, in some of the mountain-gorges, where there has never been any native population, there are stands of rain-forest with an average height of about 150 feet.

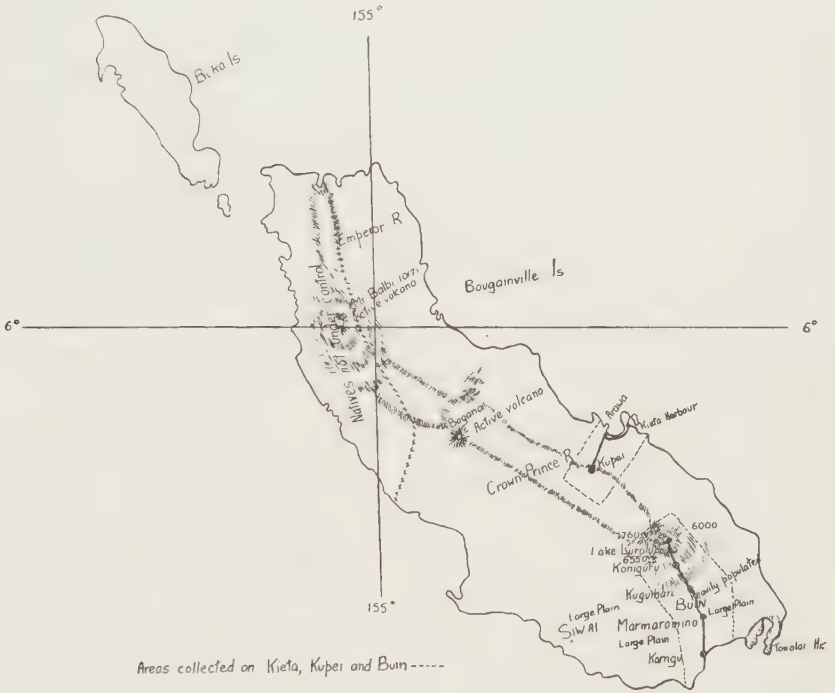

FIG. 1. Sketch map of Bougainville, showing areas visited by the writer.

For a few weeks I collected in the vicinity of Kieta (see map, *fig. 1*), where there is a fairly large population; consequently the majority of my specimens from this area were from regrowth forms of vegetation. Subsequently I extended my operations to Kupei, in the mountains, which is reached by a fairly good native road constructed because of the discovery of a copper lode there. The lode is at an elevation of 3,000 feet, and a house built there for Europeans served as an excellent headquarters.

It is interesting to note that the genus *Casuarina* is found at this altitude, although it is absent from the intervening strip between the sea-coast and 3,000 feet. A *Dacrydium* is also found here, but it is by no means plentiful.

Kupei Goldfield (or perhaps it should be called Copperfield, since the lode is a reef with about 15 percent of copper and a small percentage of gold in it) is about nine miles inland from the northeast coast. Kupei is the name of the last village on the trail, but the lode is approximately 1,500 feet higher. Farther inland the mountains ascend to nearly 6,000 feet, forming the backbone of the island, and consequently precipitation is very heavy. Rain occurs essentially every day, and the region is shrouded in heavy mist for six to eight hours of each day. The sun may be observed shining in the morning, with a few light clouds, when suddenly and without warning banks of clouds come from nowhere and darken the whole atmosphere. The afternoons are invariably misty and foggy. Under these conditions everything in camp is moist and uncomfortable, and the drying of plants is exceedingly difficult. Without the use of artificial heat a collector would find his work impossible. Toward evening the rain ceases and the nights are usually fine. The climate is comparatively cool, perhaps about 15° F. cooler, day and night, than on the coast.

In this vicinity a giant black-stemmed banana is very abundant, the plants being up to 30 feet high; the fibers of this plant should be investigated for commercial possibilities. Several species of *Begonia* are very striking, one species in particular having very showy pistillate flowers and shiny pinkish purple iridescent foliage; it seeds freely in the native state and may prove desirable for greenhouse culture. Tree-ferns, species of *Asplenium*, and various epiphytic plants are abundant in the vicinity of the goldfield, but orchids are scarce. A medium-sized *Casuarina* is peculiar to this level. Moisture-loving plants are naturally common, and mosses and lichens, although not as plentiful as one might suppose, are nevertheless abundant. I have visited other mountains with a lighter rainfall where the rocks and trees are much more heavily covered with cryptogams. The soil near the goldfield is very porous, and one may anticipate that all soluble plant food will soon be leached away if the rain-forest is cleared for cultivation. Consequently it would be necessary to emulate the native agriculture and to clear patches of forest annually, if this region should ever attract a large population.

Turning to the south coast of Bougainville, one finds a very different type of country, due to the fact that the southern end of the island is occupied by a large fertile plain. This plain should have great agricultural possibilities in the future. It is composed of volcanic drift and supports a large native population. The Buin district is very rich in palms, in this respect being the richest locality I have ever encountered. Although the plain is low-lying, it is not swampy, the land rising gradually from sea-level to the foothills. The actual strand-flora, of course, contains the usual pan-Pacific elements. The rainfall of Buin is between two hundred

and three hundred inches annually; nevertheless regions away from the coast are reasonably healthy and mosquitoes are not unbearable, since the drainage prevents the accumulation of large amounts of standing water.

On the Buin and Siwai plains (see map, *fig. 1*) one is impressed by the good roads which are maintained by the natives under government supervision. There are about 20,000 natives in this area, and the Patrol Officer can do much of his traveling by bicycle; this seems strange in a region where the only other non-native inhabitants are a few missionaries. A predominating feature is the large number of huge trees left standing by the natives. These are trees of economic value, and they tower above the lower regrowth rain-forest, being 150 to 200 feet high. They have been left undisturbed for centuries, as one can see by their dimensions. Notable examples are specimens of *Canarium*, native mangoes, breadfruit trees, *Syzygium*, *Ficus*, etc.

In the high mountain-ranges around Lake Luralu, one is impressed by the giant timber provided by specimens of *Calophyllum*, *Albizzia*, etc. The lake itself is worthy of mention; it is serpentine in shape and is the sacred place of the natives of the plains. Cremation is practiced in this region, and the dead are supposed to go to the lake and there wash off their ashes, subsequent to which they spend a happy spiritual life in the vicinity. It is difficult to persuade natives to go to Lake Luralu, and I appreciated the assistance of Patrol Officer Ward, who not only accompanied me but also arranged for native carriers. The lake has an elevation of about 5,500 feet and the vegetation in its vicinity is stunted. Species of *Rhododendron* occur there, one of them with large white flowers being suggestive of a garden azalea. Parasitic tree-forms are also in evidence. The whole mountainous area is for the greater part of the time shrouded in fog, and mosses and lichens are abundant; it is certainly one of the most interesting areas of Bougainville from a botanical viewpoint.

MALAITA

From Bougainville I went to the British Solomons, where I received less coöperation than from the authorities on Bougainville. The British Solomons appeared to me to be administered in a comparatively lackadaisical fashion, the hill tribes being encouraged to come and live on the coast. This is a great mistake, as the interior, already difficult of access, is even less approachable after the natives have left. On the island of Malaita the resident government official not only refused to coöperate with me, but he influenced the natives in such a way that I could not obtain carriers. Consequently my work on this island, toward the end of 1930, was very limited (see map, *fig. 2*).

GUADALCANAL

Guadalcanal, where I spent the entire year of 1931, is an extremely interesting island botanically. On the north coast there are extensive

stretches of grassy plains which consist of upraised ocean-floor, as shown by recent marine fossils. These fossils are very abundant and are seen in formations more than 100 feet thick, on exposed slopes of foothills. The plains are covered by a species of *Themeda* which grows to a height of about six feet and provides good fodder for cattle. Consequently large numbers of cattle and horses are pastured on the island. The pastures are in belts which are practically treeless, surrounded by patches of lowland

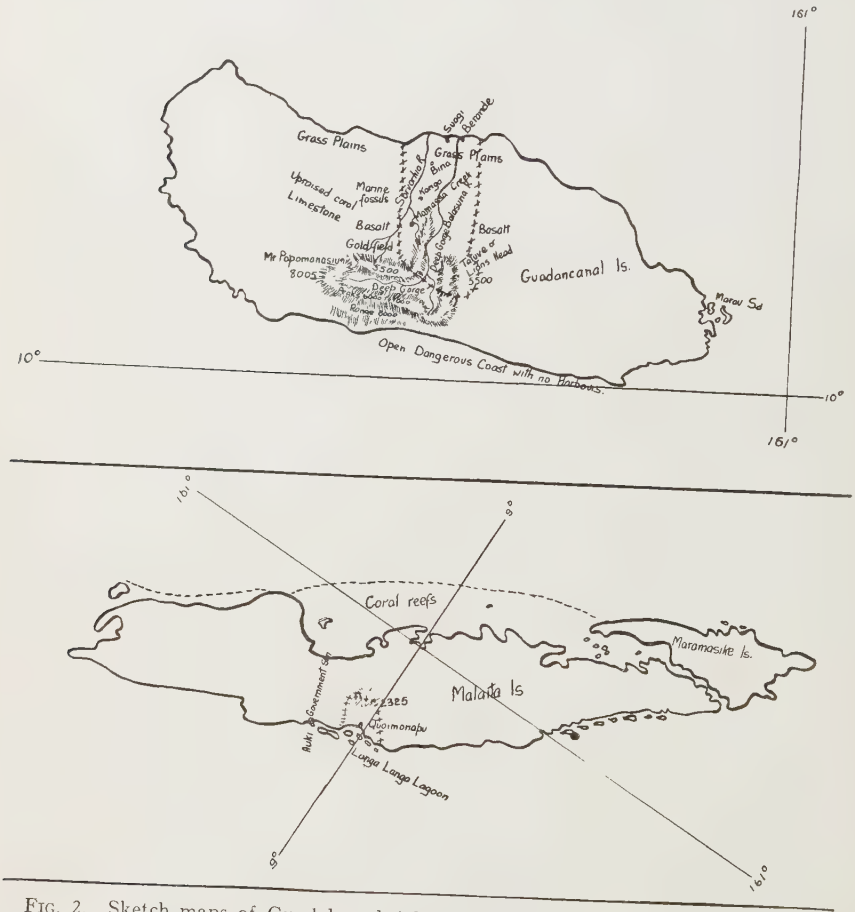

FIG. 2. Sketch maps of Guadalcanal (above) and Malaita (below), showing areas visited by the writer.

rain-forest and extending in a limited manner to the foothills. The only reason I can advance to account for the fact that these plains are not occupied by rain-forest is due to native methods of hunting. The grass has perhaps been fired by the natives for generations in order to drive out the pigs. When a strong wind is blowing the flames can destroy the

edges of the bordering rain-forest for a width of a couple of chains. Thus aided, the grass-plains appear to be slowly but surely extending and encroaching on the forest.

The next formation toward the interior is marked by the beds of marine fossils mentioned above, in which many of the present-day forms of sea-life are visible. Here grass and forests mingle on the foothills, gradually merging into the primeval types of rain-forest. In gorges the trees attain very large dimensions, a species of *Calophyllum* being especially noteworthy.

I may mention, in passing, that I once collected on a supposedly sacred mountain, and subsequently was tried by the government for violating a native sanctuary. Although I was freed of the charge, this will illustrate my contention that government officials in the British islands were not exactly coöperative. The "sacred" mountain is a bold upstanding mass named Mt. Tatuve (Tutuve), or the Lion's Head (see map, *fig. 2*). My collections from this region were of unusual interest, although the rainfall is much less than on Bougainville. The only showy flowering plants on the mountain-tops are species of *Rhododendron*. In this vicinity I obtained a great deal of information pertaining to the superstitious usages of plants by the natives, but no plants of outstanding merit for medicinal purposes were discovered. As these natives were living in a stone-age civilization upon the arrival of the white men, it may safely be assumed that they had no systematic methods of treating diseases.

FOOD PLANTS

The inhabitants of the Solomons are skilled in agriculture of a type not much advanced over the stone-age. In this region nature is so provident that food can be grown simply and with a minimum of exertion. In the following paragraphs I shall discuss the principal plants which the natives used in their domestic requirements.

Taro, *Colocasia esculenta* (L.) Schott. Taro is perhaps the most valuable food plant in the entire western Pacific. There are innumerable forms and local varieties, perhaps running into the hundreds. For convenience, the varieties may be divided into two groups, like rice — the upland and the swamp varieties. The upland type is the one universally cultivated, the swamp type being much coarser but yielding larger corms. In the wild state all the forms have a fibrous corm of inferior quality, containing a greater amount of calcium oxalate crystals than the cultivated forms. To obtain a long starchy corm has doubtless taken a very long period of cultivation and selection.

Planting the taro is a simple but effective procedure. A cylindrical hole about eighteen inches deep is made with a large stick, and in the hole the head of a taro plant of which the corm has been eaten is placed, the long leaves protruding from the hole. The heavy rains fill in the hole, and so the native is spared even this slight effort. After about nine months the

corm is large enough to be gathered and eaten, usually being either baked or boiled. The top portion, with the leaves attached, is replanted. Reproduction is also effected by allowing the plants to sucker, the new shoots then being planted; these new shoots mature more slowly than the tops of old plants.

On some islands, and especially in mountainous districts, hillside streams are diverted around terraces and large quantities of a water taro are grown. This variety grows with its roots in the water and attains a height of about six feet, with correspondingly large corms. The stream taro is not as popular as the upland forms, and probably only about five percent of the taros used in the Solomons are of this type.

In general, the taro will not thrive in regions of low rainfall. It makes up the bulk of the food of the natives in the interiors of all the large islands. Europeans are not usually fond of this food, as the corms are inclined to be more fibrous than are those of most cultivated vegetables; nevertheless the taro is excellent as a change of diet and is not to be despised in cases of necessity. It must be remembered that all taros must be cooked before being eaten, in order to render innocuous the calcium oxalate crystals. I recall one case in which a District Officer suspected the use of taro juice as a poison. According to the native evidence, the raw juice was put into cooked food, thus causing severe pain in the victim's throat. Although such pain would not be fatal by any means, the native mind is very susceptible to imagination, and it is not impossible that death might be caused by the mere thought of having been poisoned.

YAM, *Dioscorea* spp. Next in importance to taro in the Solomons are yams, which are cultivated in the drier areas, as they will tolerate fairly long periods of drought. Soils near the beaches are usually more sandy than those of the interior, and yams seem to prefer this type of soil. However, they are sometimes grown on wet islands, and I believe that tradition has a great deal to do with whether islanders of certain regions prefer yams or taros. There is an endless variety of yams, from monsters 70 to 80 pounds in weight to small ones the size of carrots. Owing to the fact that their runners need large supports, yams are suitable to newly felled areas of virgin bush, where plenty of large branches are left for the plants to climb over. After the yams have been harvested, bananas are planted in the same area and are left to grow in competition with the tall weeds; in a few years the field becomes jungle-covered and after about ten years it may again be cleared and used for another crop of yams.

Both yams and taros may be cooked in a variety of ways. Often they are boiled and mashed, and to the sticky mass grated coconuts are added, or sometimes the grated kernels of *Canarium* nuts. If the latter nuts are used, they are usually first hung over a fire and smoked and allowed to become rancid; the resultant strong flavor adds piquancy to the dish in the opinion of the natives. There are several species of aromatic herbs which the natives sometimes add to starchy foods. These herbs are in demand at feast times, but usually it is considered too much trouble to

gather and prepare them. As long as food is available the natives seldom need any appetizer; they do not like vegetables cooked too soft, even rice, when available, being cooked in a manner almost indigestible to Europeans.

In my observation, the natives of the Solomons are not as highly skilled agriculturists as those of Tanna, in the New Hebrides. The Tannese have raised the cultivation of yams to a very high standard. They sift the soil and make high mounds, rich in humus and bacteria, in which the yam is planted: the vines are trained over well-built supports, and the resultant crop is very large, yams of 70 or 80 pounds being commonplace. The Tannese build yam houses with ventilated sides and store the yams for as long as nine months, until the new crop is ready. In other parts of the western Pacific I have not observed such a high standard of agriculture as on Tanna, the natives of which are quite superior both physically and intellectually.

Wild bananas, *Musa* spp. In one form or another, wild bananas are met with frequently in the rain-forests. In fact, one observes patches of giant bananas, with trunks up to 30 or 40 feet high, growing in dense stands with little or no other vegetation. They prefer wet or damp situations, such as the slopes of the high mountain ranges on Bougainville. All the wild ripe fruits I saw in the Solomons were of an orange color, insipid in taste, the pulp being full of small black seeds.

The banana has a multiplicity of uses, pertaining to food, clothing, fibers, sap used as a dye, etc. As a food it enters largely into the dishes prepared for feasts, as it is always one of the constituents of native puddings. It is noteworthy that the same type of pudding is found throughout the western Pacific and even extending eastward. It is prepared by grating and kneading a starchy material, such as yam or taro, to which is added the flesh of fish or fowl, and bananas. Of course the fruits are also cooked in a variety of other ways, being baked, boiled, or even fried — the latter method being copied from the whites.

The leaves of the banana are used for wrapping meat, fish, or puddings, which are then steamed on glowing coals. Additional banana leaves are heaped on top to keep in the heat, and after about three hours the food is excellently cooked. Skirts are manufactured from the leaves with a minimum of effort. The frond of a large banana, ten feet long or more, is split down the middle of the midrib, and the blades of the two portions are then split like combs and placed on hot sand to dry. The blades shrink to a wispy material, and about half a dozen layers are worn as a skirt, thus solving the clothing problem very easily for the ladies. In the Santa Cruz group the fiber from the stems of bananas is woven into mats and baskets, by means of a loom and shuttle. Considering the crudeness of the apparatus, very beautiful work is done and colored patterns are skillfully introduced.

Sago palm, *Metroxylon salomonense* (Warb.) Becc. Among the most valuable plants of the Solomons, the coconut palm would of course rank very high, but so much has been written about the uses of this species

that I can add nothing. Another very valuable palm, the sago palm, however, is also of extreme value to the natives. Its fronds supply one of the most popular and durable thatches; the large pinnae are stripped off and sewn together on a pole, these poles being used in a manner similar to shingles. European houses in isolated places in the Solomons are similarly thatched, as roofs of this material provide very cool houses.

The trunk of the *Metroxylon* supplies huge quantities of sago, which is gathered after the tree has flowered and fruited, usually after about 20 years of growth. When this period arrives, the tree is felled, the trunk split, and the starch grains loosened by beating. The particles are then washed in troughs full of water, and the starch sinks to the bottom, from which it is collected and spread in the sun to dry. The starch has the appearance of arrowroot, as which it is sometimes used by the white settlers. Used by itself it is very constipating, and so a great deal of coconut oil is mixed with it in cooking.

Great quantities of the nuts of the sago palm are collected every year and sold to Japan as ivory nuts of commerce, being used as a substitute for ivory in cheap articles and in the manufacture of buttons. These nuts are said to be not as good as the ivory nuts of South America (*Phytelephas macrocarpa* R. & P. or spp.), but at times there is a considerable demand for them owing to the proximity of the Japanese market.

Other palms. Buin, in southern Bougainville, is strikingly rich in native palms, which cannot be said of all the islands. However, the Solomons are doubtless richer in palms, on the whole, than the New Hebrides. The uses of palms in the native economy are legion. The trunks of all species have a pithy center and an extremely hard exterior; they are very easily split, after which the soft pith is chopped away and the remaining lathe-like strips used for a very durable flooring in native houses. The outer part of the trunk of the taller species is very hard and takes a good polish, and this wood has been used for centuries in making bows, spears, and other weapons. When making a temporary camp in the bush, the natives use the fronds of any species for shelters. The fronds of the broader cabbage-leaf type are made into light mats on which the natives sleep and which they carry over their heads as a protection against rain.

The crown or undeveloped young fronds of some species can be boiled and eaten as a vegetable. The head of the palm is cut open and the soft immature fronds removed, the coconut palm being especially prized as a source of a salad. Of special interest is the nipa palm, *Nipa fruticans* Thunb. The natives collect the fronds of this species and burn them when they are dry, the resultant ash being used in a manner similar to salt.

Breadfruit, *Artocarpus altilis* (Parkinson) Fosberg. Every traveler refers to the breadfruit, one of the principal food plants of the Pacific. In addition to its edible fruit, it possesses a very valuable sap which serves as a strong glue in the manufacture and mending of canoes. The trunks

ot the trees also make very good canoes, but the fruit is too valuable to permit of many trees being used in this way.

Narli nuts, *Canarium* spp. Species of *Canarium* have a wide distribution over the whole of the southwestern Pacific. The trees have very large flanges or buttresses and a tall light-colored trunk, and they are outstanding in the rain-forest. The genus is of great economic value, as its members produce great quantities of nuts, which have an exceptionally high food value, being esteemed by natives and whites alike. As the native is essentially a vegetarian, the oil-ration provided by *Canarium* nuts is a decided addition to his diet. Immense crops of the nuts are produced for four, five, and even six months of the year. They are smoked and preserved in various ways, this being the only food which is stored except for yams and breadfruit, in my observation. The mountain natives make regular pilgrimages down to the coast to barter for the nuts, using them to flavor taro puddings. Wherever the natives destroy the forest for the purpose of making gardens they leave the *Canarium* trees, taking great care that fires do not scorch or damage them. As a result, these trees are very numerous and large, often with a height of 140 feet and a diameter of six feet.

Canarium nuts are known as "garlips" in the Mandated Territory, "sailor" in the Solomons, "narli" in the Santa Cruz group, and "nungi" or "ni" in the New Hebrides. There is a wide range of varieties and species. The largest and oiliest nuts come from the Santa Cruz group, from a tree comparatively small in stature but bearing tremendous crops. One wonders whether this prolific tree could be the result of long cultivation and selection. The timber of *Canarium* might be of value as a cabinet wood, but I do not know of a single instance where a tree has been felled, as this would be sacrilege in the eyes of the natives. In the Mandated Territories it is illegal to cut any of these trees or any other trees which are used for food by the natives.

Upolu or Ooperu, *Gnetum gnemon* L. This species is a large factor in the supply of green vegetables in the Solomons. Everywhere along the roads in Buin on southern Bougainville one can see the trees growing, as they have been left by the natives when the rain-forest was cleared. The tree has a tall erect pine-like manner of growth; whether this is natural or whether it is caused by the continual stripping off of the smaller branches I am unable to say. The method of collecting the leaves is amusing; a young boy is selected to climb the tree and break off the young branches, which are thrown down to natives under the tree. Only the terminal leaves are removed from these branches, and these young leaves are then boiled and eaten like cabbage. This vegetable has a unique flavor which is entirely pleasing to most Europeans.

In a somewhat similar manner the young leaves of "akamu" (*Polyporandra scandens* Becc.) and "numarrie" (*Rhyticaryum* sp., *Kajewski 2072*), both of the Icacinaceae, are prepared and eaten.

Figs, *Ficus* spp. The figs of the South Pacific are very difficult to

classify botanically, as the species are numerous and variable. Before the arrival of the white men, figs probably had a more important place in the native economy than at present. One species has a strong thick bark which was beaten out to make a cloth resembling tapa (from *Broussonetia papyrifera* Vent.). The thicker portions of this bark were not beaten out but were cut into long strips, being used for thongs in a manner similar to leather.

The large fleshy leaves of some species are cooked and eaten as vegetables; I have tried these and have found them excellent, if only the young and tender leaves from the apices of branchlets were selected. The leaves of other species are very rough and are used as sandpaper, to finish native weapons such as spears and also to polish ornaments, combs, etc. The fruits of most figs are eaten by fruit-loving birds such as pigeons and hornbills.

Pipers, *Piper* spp. The genus *Piper* is widely distributed throughout the tropics, supplying the pepper of commerce and the "kava" (*Piper methysticum* Forst. f.) of Polynesia. Kava-drinking is not indulged in in the Solomons, but the betel nut is extensively used. There is a sharp dividing line between these two customs, which coincides with the political boundary between the New Hebrides and the Santa Cruz group. Betel nut chewing is unknown in the New Hebrides.

The leaves of some pipers have a very pleasant odor when bruised, and are used by the natives to rub on their bodies. Other species play an important part in native religions, the fruits or roots sometimes being burned to frighten away evil spirits. The leaves of another species (*Kajewski 2185*) are rubbed over the body in order to drive out a poison or to banish a devil. Many species are rich in essential oils, and I have no doubt that the indigenous pipers of Bougainville will be worth chemical investigation.

Pandan, *Pandanus* spp. In strand floras throughout the Pacific and often found inland up to 5,000 feet elevation are many different species of *Pandanus*. Some species attain a stature of 30 or 40 feet, a notable example of a tall species occurring on the Crown Prince Range of Bougainville, where there are pure stands with little or no forest of other constituents. Pandans have a multiplicity of uses for the islanders. The long leaves are split, after soaking and bleaching in salt-water, and are plaited into mats, baskets, and "grass" skirts. This work is done by the women, and great jealousy is attached to the rights to leaves from certain plants concerning which a sort of priority has been established. In one case I knew of a woman who cut down one of "her" trees because another woman had gathered leaves from it.

Pandan fruits contain small oily kernels which provide a very concentrated food in case of emergency, although to gather the kernels is slow work. The juice of the ripe fleshy fruits is also palatable, and the head has a fine fruity fragrance when ripe.

Barringtonias, *Barringtonia* spp. Some species of this genus have non-

edible fruits which are sometimes considered poisonous, this type being associated with swamps. The nuts of other species are edible and the tree is worth cultivating for this reason as well as for its ornamental value. The fruits have a fibrous outer covering, the kernels having a taste similar to the almond.

General superstitions. The natives of the Solomon Islands have many quaint superstitions which have been handed down for centuries; their whole lives, in fact, are wrapped in superstition. When a native builds a house, the first thing he thinks of is to grow suitable plants to stop the evil spirits from entering his house as he sleeps. Sometimes, in villages, there is a fringe or boundary of these protective plants around the whole village. When a house stands by itself even greater efforts are taken to protect it by the judicious use of plants, since the spirits are more forward where solitary houses are concerned. The plants most widely used for this purpose are wild aromatic gingers, which give off a pungent odor when crushed. Highly decorative plants such as crotons, euphorbias, and hisbiscus are used to please the spirits. This of course is the case in pagan villages; in Christian villages these customs would be distorted, but nevertheless the same plants are still used as ornamentals.

When the pagan native starts to clear the rain-forest, he knows that he is going to offend the spirits by making the forest unsightly, and so he tries to appease them by leaving certain plants standing. These plants vary from island to island, but certain aromatic plants like wild gingers are invariably left undisturbed. Again, when the crops are planted, certain gay decorative and aromatic plants are allowed to grow with the crops, as though the native were reassuring the spirits that he intended to leave the land beautiful. Certain areas or patches of forest are "tambu" and their cutting is forbidden, for which reason one often sees a patch of tall undisturbed forest near a village.

The islanders are very fond of aromatic plants and grow many of them for ornamental purposes and for perfume. One observes the greatest use of these at feast times. Traders exploit this desire for strong perfumes by importing cheap scents which in some districts are replacing the native plants for this purpose.

Methods of gardening. For ages past the natives of the Solomons have been tillers of the soil. A strong tropical sun, a genial climate with no great extremes, bounteous rainfall, and rich soil enable them to produce all the food they require with little effort. The gardens are primitive affairs, with no attempt at serious cultivation. The only great effort is to erect pig-proof fences, for all the pigs, although native-owned, run wild and depend for their livelihood upon their foraging propensities.

The staple of the native diet is taro, and as the native eats but one regular large meal a day he has to plant about 500 taros for a food-supply of six months to one year. He can also, if inclined, set out a few banana suckers, some sweet potatoes, and some tapioca in addition to the plants discussed above. Meanwhile, a single sago palm will provide an enormous

quantity of food. The *Areca* nut grows in a semi-wild state, and so his betel nut stimulant costs nothing. Coconuts are grown everywhere up to an altitude of 1,500 feet, while other nuts provide edible oils, and young leaves of various plants provide greens. Tobacco grows almost wild and can be dried and twisted with very little trouble. It is only the desire for trade goods — knives, other tools, mirrors, and calico — that causes the native to condescend to work for the white man.

To prepare a garden the native selects a piece of bush that has not been cultivated for many years, the longer the better. All the trees except the larger ones are felled, allowed to dry, and fired. The unburned logs are piled up against the larger trees, which are sometimes then killed by a second fire. Next the native builds his pig-fence, and his share of the operation is completed. The planting, harvesting, gathering firewood, and cooking are left to the women. One might suggest, in conclusion, that exponents of women's rights would have grounds for a campaign in the Solomons.

THE GENUS ESCHWEILERA IN TRINIDAD AND TOBAGO

A. C. Smith and J. S. Beard

In his Flora of Trinidad and Tobago, R. O. Williams (1: 353. 1934) recognizes two species of *Eschweilera* (Lecythidaceae), one occurring in Trinidad and one in Tobago. The present writers, although agreeing with Williams in referring the common lowland Trinidad form to *E. subglandulosa*, believe that a species occurring in the montane rain-forest of Mt. Tucuche is undescribed. Furthermore, we cannot concur in referring the Tobago plant to *E. decolorans* Sandwith, of British Guiana; this Tobago entity appears to us to be undescribed and below we present a description of it. Although the authors of this paper are jointly responsible for the conclusions expressed, the formal descriptions and the synonymy were prepared by the first author, while the second author assembled the ecological data, largely on the basis of his own field-study.

Herbarium specimens are cited from the Arnold Arboretum (A), Gray Herbarium (GH), Imperial College of Tropical Agriculture, Trinidad (ICTA), New York Botanical Garden (NY), Royal Botanic Garden, Trinidad (Trin), and U. S. National Herbarium (US). We are indebted to the directors and curators of those institutions from which material has been borrowed for the purposes of this study.

Eschweilera subglandulosa (Steud.) Miers in Trans. Linn. Soc. 30: 266. 1874; Eyma in Pulle, Fl. Surinam 3 (1): 134. 1934; R. O. Williams, Fl. Trin. & Tobago 1: 253. 1934; Knuth in Pflanzenr. 105 (IV. 219a): 106. 1939.

Lecythis subglandulosa Steud. ex Berg in Linnaea 27: 459. 1854.

Lecythis laevifolia Griseb. Fl. Brit. W. Ind. 711, nomen. 1864; Urban in Bot. Jahrb. 19: 670, nomen. 1895.

Eschweilera laevifolia Miers in Trans. Linn. Soc. 30: 256. *pl. 60, f. 15.* 1874; Knuth in Pflanzenr. 105 (IV. 219a): 99. 1939.

Trinidad: Arena Reserve, alt. 75 m., *Beard 148* (A) (tree 40 m. high, in evergreen seasonal forest; trunk 60 cm. diam.; petals cream-yellow; timber useful; local name: *guatecare*); North Post Road, *Britton, Hazen, & Mendelson 773* (GH, NY, US) (tree 20 m. high, on hillside); St. Anne's Valley, *Broadway 3620* (Trin); without locality, *Fairchild 2857* (A).

On the basis of the cited material and examination of the original and subsequent descriptions, we are inclined to agree with Williams in reducing *E. laevifolia*, presumed to be endemic to Trinidad, to the South American *E. subglandulosa*. No differences are apparent between our specimens and several available from British Guiana. In his recent work, Knuth makes no comparison between the two species, both of which are maintained by him.

Eschweilera subglandulosa ("guatecare"), as it occurs in Trinidad, is a large evergreen tree up to 40 m. in height, with a long cylindric erect trunk up to 75 cm. (or occasionally more) in diameter, branching high up, and

with small buttresses. The bark is dark gray to black, somewhat smooth, about 0.5 cm. thick, hard, and slightly fibrous. The wood is white, turning gray when seasoned; it is close-grained and without distinct heartwood. The timber is very hard, heavy, and difficult to work; it is usually hewn rather than sawn into sleepers, posts, and heavy timbers. It is prized for its natural durability in contact with the ground, being resistant to both fungi and termites.

This species is one of the principal dominants of the most widespread forest type of the Trinidad lowlands-evergreen seasonal forest — and has given its name to the *Carapa guianensis–Eschweilera subglandulosa* association of that formation. It is absent from Tobago. In the foothills of the Northern Range of Trinidad (a) it is only of the order of frequent, but it is abundant in the forests of the northern plain (b) and Central Range (c), and it is very abundant on the southern hills and peneplain (d). It becomes abundant also in a drier type of forest in the southern hills, the *Peltogyne porphyrocardia–Mouriria Marshallii* association of semi-evergreen seasonal forest (e). It does not become such a large tree in the semi-evergreen forest, while in other forest types than the five mentioned above the tree is casual and rare.

TABLE 1.

NUMERICAL OCCURRENCE OF ESCHWEILERA SUBGLANDULOSA IN FOREST TYPES IN TRINIDAD; INDIVIDUALS PER 100 ACRES

Locality	Number of trees in girth classes (girth in feet)										
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	over 10	Totals
a[1]	38	12	4	4	6	2	2	—	—	—	68
b	194	116	54	54	26	12	6	2	—	6	470
c	108	69	35	30	20	2	6	1	1	1	273
d	234	366	201	231	87	48	21	21	6	3	1218
e	100	136	22	24	14	—	—	—	—	—	296

[1] The letters in the left-hand column refer to the localities mentioned in the text above.

The habitat of the plant is characterized by a seasonal rainfall regime with from 1750 to 3000 mm. of rain annually, distributed in a dry season from January to April, with 50 to 80 mm. of rain per month, and a rainy season from May to December, with 100 mm. and upward per month. Mean annual temperature is about 78° F. There is little exposure to strong winds. Topography embraces all types from mountains to plains, and soil types include all except the extremes of excessively freely drained and waterlogged. Apparently the tree occurs in British Guiana in a similar habitat.

Eschweilera subglandulosa is a forest dominant in the sense of physical and numerical superiority, being one of the most abundant trees of the uppermost forest stratum. It is not uniformly distributed, since the *Carapa-Eschweilera* association is divisible into two distinct alternes corresponding to site differences between ridge and flat. *Carapa* is dominant on the badly drained flats with intermittently high water-table — *Eschweilera* on the dry ridges with compact soil and no true water-table. On intermediate sites both dominants occur together. Associate dominants of the *Eschweilera* alterne are *Buchenavia capitata* (Vahl) Eichl., *Terminalia amazonia* (J. F. Gmel.) Exell, *Tabebuia serratifolia* (Vahl) Nichols., *Manilkara bidentata* (A. DC.) Chev., *Vitex divaricata* Sw., *Vitex capitata* Vahl, and *Bravaisia integerrima* (Spreng.) Standley.

Eschweilera trinitensis sp. nov.

Arbor 10–20 m. alta ubique glabra, ramulis subteretibus rugulosis primo purpurascentibus gracilibus 1.5–5 mm. diametro demum cinereis lenticellatis; petiolis canaliculatis valde rugulosis 5–13 mm. longis crassis (2–3 mm. diametro); laminis coriaceis vel valde chartaceis in sicco olivaceis ellipticis vel oblongo-ellipticis, (7–) 10–26 cm. longis, 4–12 cm. latis, basi obtusis vel subrotundatis et in petiolum leviter decurrentibus, in apicem callosum 0.5–1.5 cm. longum cuspidatis, margine cartilagineis integris vel obscure undulatis, costa supra plana vel subprominente subtus valde prominente, nervis secundariis principalibus utrinsecus 7–14 arcuato-adscendentibus marginem versus obscure anastomosantibus supra planis vel prominulis subtus valde elevatis, rete venularum copiose intricato supra immerso vel prominulo subtus valde prominulo; inflorescentia axillari vel subterminali sub anthesi 6–12 cm. longa anguste paniculata ut videtur ad 25-flora, rhachi angulata valde rugulosa 2–4 mm. crassa haud flexuosa, ramulis lateralibus 2–8 adscendentibus ad 3 cm. longis gracilibus; pedicellis teretibus haud bracteolatis 5–8 mm. longis superne 2–3 mm. diametro, basi valde contractis et articulatis, parte inferiore persistente subnulla in pulvino bilobato inconspicuo complanata; calyce sub anthesi ad 12 mm. diametro, sepalis subcoriaceis semiorbiculari-deltoideis circiter 4 × 5 mm. subintegris obtusis; petalis tenuiter carnosis vel in sicco papyraceis ellipticis vel oblongo-obovatis, sub anthesi ad 2 cm. longis et 1.5 cm. latis, obscure nervatis, apice rotundatis, margine obscure denticulatis vel integris; androphoro carnoso explanato circiter 2 cm. longo, super annulo circiter 12 mm. lato, galea spiraliter incurvata circiter 13 mm. lata, parte apicali inflexa extus appendiculis crassis acutis 3–5 mm. longis ornata; staminibus circa annulum et paullo supra numerosissimis, filamentis carnosis subteretibus 0.7–1.2 mm. longis superne incrassatis, antheris oblongis 0.5–0.7 mm. longis; ovario semisupero sub anthesi circiter 3 mm. diametro, in stylum brevem conicum truncatum ad 1 mm. longum umbonato, loculis 4, ovulis in quoque loculo e basi erectis ut videtur 3 (2 4?); inflorescentia sub fructu valde incrassata, pedicellis ad 5 mm. diametro; pyxidio maturo depresso-subgloboso ad 4.5 cm. longo et 5.3 cm. lato, parte infracalycari cupuliformi 2–2.5 cm. alta rugulosa, calycis lobis coriaceis obviis obtusis, vitta interzonali incurvata 3–9 mm. alta, operculo convexo 5–10 mm. alto ad 4 cm. diametro, pericarpio lignoso 3–4 mm. crasso 2–4-loculari, seminibus in quoque loculo 1 vel 2 ad 3 × 2 cm.

TRINIDAD: El Tucuche, in montane rain-forest, alt. 900–1000 m., *J. S. Beard 147* (A, TYPE), Oct. 1, 1943 (tree 15 m. high; trunk 30 cm. diam.; flowers yellow; local name: *mountain guatecare*), *Beard 471* (A, Trin), *472* (A, Trin), April 20, 1945 (trees 10 m. high; trunk 30 cm. diam.; bark soft and stringy).

Of the cited specimens, no. *147* bears flowers and is accompanied by detached immature fruits, no. *471* bears immature fruits, and no. *472* has mature fruits from which the above dimensions are taken. Although there seems no doubt that a single species is represented by these collections, it should be noted that the leaves of no. *472* are on the average considerably larger than those of the other two numbers, although smaller leaves also occur on this specimen. The number of secondary nerves is also greater in the leaves of no. *472*. In general, the maximum dimensions given above pertain to this specimen, the smaller dimensions to nos. *147* and *471*. The variation present seems normal for a species of *Eschweilera* and may be due to conditions of shade or exposure.

The differences between the new species and the common lowland species of Trinidad, *E. subglandulosa*, are obvious, the two even falling into different genera if the classifications of Miers and Knuth are adopted. Among the species of *Eschweilera* with predominantly 4 ovary-locules (*Chytroma* Miers), our plant seems closest to *E. decolorans* Sandwith, of lowland British Guiana, of which we have several specimens for comparison (*Sandwith 348* [type coll., NY, US], *414* [NY], *Jenman 2474* [NY], *Forest Dept. 920* [ICTA], *2563* [NY]). From *E. decolorans*, *E. trinitensis* differs primarily in having its inflorescence narrowly paniculate rather than usually simply racemose, in having its pedicels shorter, articulate at the base, and ebracteolate rather than articulate above the base and with obvious bracteoles, and in its smaller flowers (this character being obvious in dimensions of the sepals, petals, filaments, staminodes, and ovary). The petals of *E. decolorans* are said to be pure white or creamy white, while those of the new species are distinctly yellow. In foliage the two species are essentially similar, but the leaf-blades of *E. trinitensis* have the secondary nerves more closely approaching the margin and there weakly anastomosing by means of inconspicuous connecting nerves, while the blades of *E. decolorans* have the secondaries more distinctly interconnected somewhat farther from the margin. The proportions of the pyxidia of the two species provide further distinguishing features; for a discussion of the fruits of *E. decolorans* see our note under *E. Sandwithiana*, described below.

The character upon which *Chytroma* is separated from *Eschweilera* (cf. Knuth in Pflanzenr. 105 [IV. 219a]. 1939) — the presence of 4 rather than 2 ovary-locules — often seems to separate closely related species and furthermore is not always dependable, as already pointed out by Eyma (Polygon., Gutt., Lecyth. Surinam 66. 1932).

Eschweilera trinitensis ("mountain guatecare") is a medium-sized evergreen tree up to 20 m. in height, with a trunk up to 75 cm. in diameter. Its trunk is usually short and thick, slightly buttressed, and with heavy

and spreading branches. The bark is dark gray to black, smooth, soft and fibrous, and about 1 cm. thick on old trees. The wood is white, close-grained and moderately hard, with no distinct heartwood. As the tree occurs only in fairly inaccessible places, the timber is never worked and nothing is known of its quality.

This species is one of the principal dominants in the montane rain-forest which is localized at the summits of the two highest peaks in the Northern Range of Trinidad — Tucuche and Aripo — above 800 m. elevation. The tree is unknown elsewhere in Trinidad, its distribution being confined to an area of only several hundred acres. The second author believes that he has seen it in forest of a similar type in the mountains of the Paria Peninsula of Venezuela, a range formerly continuous with the Northern Range of Trinidad, but this occurrence is not at present supported by herbarium specimens.

Enumerations show this species to occur at an average rate of 15 trees per acre over 10 cm. in diameter in the montane rain-forest — a figure representing about 16% of the crop. It ranks third in numbers in the association, *Licania biglandulosa* Griseb. and *Richeria grandis* Vahl being each slightly more abundant. The *Eschweilera*, however, grows to be a bigger tree than any of its associates. Other less common members of the association are *Oreopanax capitatus* (Jacq.) Dec. & Planch., *Croton roraimensis* Croizat, *Chimarrhis cymosa* Jacq., *Euterpe Broadwayana* Becc., *Prestoea pubigera* (Griseb. & Wendl.) Nichols., and *Cyathea* spp.

There are no exact data on the habitat of *Eschweilera trinitensis*. It occurs on mountain tops in the cloud belt, where the atmosphere is generally saturated. Annual rainfall is probably about 5000 mm. without any appreciable dry season, and average temperature is about 65° F. The constant wetness is shown by a thick covering of bryophytes on the trees, by luxuriant epiphytes, and by the presence of tree-ferns. The area is exposed to strong winds.

Eschweilera sp.

TRINIDAD: Blanchisseuse Reserve, *R. L. Brooks 12483* (NY); Northern Range Reserve, *Brooks 12687* (NY).

What appears to be a third species of *Eschweilera* from Trinidad is represented by the above-cited specimens. The leaf-blades of this entity are smaller than those of either *E. subglandulosa* or *E. trinitensis*, measuring 7–11 × 3–5 cm., obtuse to acute at base, with the 7–10 secondaries weakly anastomosing and the veinlet-reticulation very intricate. A single fruit accompanying no. *12483* resembles those of *E. trinitensis* but is smaller, with a thinner pericarp and a single 1-seeded locule. Collection of flowers is desired before this form can confidently be placed.

This species of *Eschweilera*, locally known as "guatecare petite feuille," is a large evergreen tree up to 30 m. in height, with a long cylindric erect trunk up to 60 cm. (or occasionally more) in diameter, branching high up, and with very small buttresses. The bark is dark gray, somewhat smooth, about 0.5 cm. thick, soft, and somewhat fibrous. The wood is

white, of moderate hardness, and reputedly of poor durability, for which reason it is only very seldom worked for timber. It is occasional in the lower montane rain-forests of the *Byrsonima-Licania* association in the Northern Range of Trinidad, at elevations between 250 and 750 m.

TABLE 2.

NUMERICAL OCCURRENCE OF ESCHWEILERA SP. IN BYRSONIMA-LICANIA ASSOCIATION OF NORTHERN RANGE OF TRINIDAD; INDIVIDUALS PER 100 ACRES

Number of trees in girth classes (girth in feet)										
1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	over 10	Totals
96	78	57	45	36	12	12	4	2	3	345

Eschweilera sp. ("guatecare petite feuille") ranks eighth in number among the dominant trees and represents about 2% of the total crop. The associate dominants are *Licania ternatensis* Hook. f., *Sterculia caribaea* R. Br., *Byrsonima spicata* (Cav.) L. C. Rich., *Licania biglandulosa* Griseb., *Micropholis Cruegeriana* Pierre, *Terminalia amazonia* (J. F. Gmel.) Exell, and *Diospyros icrensis* Britton. The habitat of this *Eschweilera* is essentially the same as that of the next species discussed, *E. Sandwithiana*.

Eschweilera Sandwithiana sp. nov.

Eschweilera decolorans sensu Williams, Fl. Trin. & Tobago 1: 354. 1934; non Sandwith.

Arbor alta ubique glabra, ramulis subteretibus striatis gracilibus apicem versus 1.5–3 mm. diametro purpurascentibus vel cinereis demum inconspicue lenticellatis; petiolis validis (2–3 mm. diametro) rugulosis supra complanatis 5–20 mm. longis; laminis valde chartaceis in sicco olivaceis vel fuscescentibus ellipticis vel oblongo-ellipticis, (11–) 17–25 cm. longis, (3–) 6–10.5 cm. latis, basi acutis vel obtusis et interdum subrotundatis, in apicem 7–15 mm. longum subito cuspidatis vel acuminatis, margine leviter revolutis et inconspicue undulato-crenulatis vel integris, costa valida utrinque prominente, nervis secundariis utrinsecus 11–15 patentibus leviter curvatis 3–7 mm. e margine regulariter et conspicue anastomosantibus supra leviter subtus valde elevatis, rete venularum intricato copioso utrinque valde prominulo; inflorescentia supra-axillari vel subterminali breviter racemosa sub anthesi 1–2 cm. longa ut videtur 5–8-flora, rhachi angulata striata 1–1.5 mm. diametro, floribus magnis; pedicellis crassis (sub anthesi 1.5–3 mm. diametro) teretibus 6–9 mm. longis superne incrassatis, basim versus articulatis haud bracteolatis, parte inferiore subnulla; sepalis (5 vel) 6 sub anthesi patentibus valde imbricatis coriaceis late ovatis vel suborbicularibus, 5–7 mm. longis, 4.5–8 mm. latis, apice rotundatis, margine interdum scariosis; petalis in sicco papyraceis suborbicularibus vel elliptico-obovatis, sub anthesi 15–20 mm. longis et 13–17 mm. latis, obscure reticulato-nervosis, apice rotundatis; androphoro explanato sub anthesi ad 4 cm. longo, ligula carnosa 2–2.5 cm. longa super annulo 1.5–2 cm. lata, galea spiraliter incurvata compacte subglobosa 15–18 mm.

diametro, parte apicali inflexa extus appendiculis crassis lanceolatis 5–6 mm. longis copiose ornata; staminibus circa annulum carnosum et paullo supra numerosissimis, filamentis carnosis clavatis longitudine diversis (0.5–3 mm. longis, eis basi ligulae longioribus) interdum anantheris, antheris oblongo-ellipsoideis, thecis 0.5–0.7 mm. longis; ovario plus minusve semisupero sub anthesi circiter 3.5 mm. diametro, in stylum crassum subconicum obtusum circiter 1.5 mm. longum producto, pariete crasso, loculis 2 vel 3, ovulis in quoque loculo 4–7 e basi erectis obovoideo-complanatis; inflorescentia sub fructu ut videtur paullo incrassata, pyxidio submaturo depresso-subgloboso ad 3 cm. longo et 3.5 cm. lato, parte infracalycari inconspicua complanata, calycis lobis coriaceis persistentibus, vitta interzonali erecto-patente 5–10 mm. alta, operculo convexo-subconico 10–15 mm. alto ad 35 mm. diametro, pericarpio lignoso 2–5 mm. crasso ruguloso ut videtur plerumque 1- vel 2-loculari, seminibus paucis.

Tobago: Roxborough, in the Forest Reserve near the 5-mile post, *I. S. Earle 12899* (Trin, type), May 16, 1933 (*devilwood* or *guatecare*); Roxborough–Bloody Bay Road, Tobago Reserve, alt. about 300 m., *C. Swabey 12941* (Trin) (*devilwood*); King's Bay Estate, *W. E. Broadway 4534* (NY); without definite locality, *R. C. Marshall 12383* (Trin) (big tree).

Although the above specimens are far from satisfactory, taken together they offer enough material to indicate that the Tobago plant is distinctly different from any encountered in Trinidad; furthermore, we are unable to match this with any continental species and therefore we have described it as new. The best flowers accompany the type, while *Swabey 12941* has the best (although broken and not fully mature) fruits. *Broadway 4534* has the only attached inflorescences, but its flowers are immature. This Broadway specimen was cited by Knuth (in Pflanzenr. 105 [IV. 219a] : 99. 1939) as *E. laevifolia*, but it is certainly distinct from that species, discussed above as *E. subglandulosa*.

Eschweilera Sandwithiana is characterized by its large and comparatively narrow acuminate leaf-blades, of which the secondary nerves are united in very regular anastomoses and the veinlet-reticulation is intricate and conspicuous on both surfaces. The fruit of the new species is notable for its small nearly flat infracalycary zone, its spreading interzonal band, and its large operculum. In having a 2- or 3-celled ovary our plant is referable to *Eschweilera* in the limited sense rather than to *Chytroma*, if indeed these two groups are worthy of even sectional recognition.

Obvious characters of leaf-texture and venation distinguish the new species from *E. subglandulosa* (Steud.) Miers. Furthermore, *E. Sandwithiana* has the inflorescence simple and compact rather than divaricately paniculate, the sepals larger, probably the androecial parts also larger at anthesis, and the fruit quite differently shaped.

From *E. decolorans* Sandwith and the above described *E. trinitensis*, the new species differs in its fewer ovary-locules with more numerous ovules, its compact inflorescence, and in minor characters of foliage and flowers. In venation, the leaves of the new species are more suggestive of those of *E. decolorans*, which has a similarly obvious veinlet-reticulation, but our plant has the anastomoses of the secondaries more regular.

Prof. E. E. Cheesman, of the Imperial College of Tropical Agriculture, Trinidad, has kindly loaned us some detached fruits said to be those of *E. decolorans* and presumably from British Guiana. These mature pyxidia, like those of our new species, have a very small flat infracalycary zone (2–3 cm. in diameter), a conspicuous calycary ridge with thickened calyx-lobes, a spreading interzonal band 2-3 cm. high and 5–6.5 cm. in diameter at the much-thickened apex, and a convex operculum 1.5–2 cm. high and up to 6 cm. in diameter. The pericarp is 5–10 mm. thick, and the number of locules varies from 1 to 4, being 3 or 4 in the largest fruits. These pyxidia are essentially similar to those of the new species in proportions, being quite different from those of *E. subglandulosa* and *E. trinitensis*.

It is a pleasure to dedicate this species to Mr. N. Y. Sandwith, of the Royal Botanic Gardens, Kew, in recognition of his valuable work on the flora of Trinidad and Tobago and his interest in the Lecythidaceae.

Eschweilera Sandwithiana is a medium-sized evergreen tree up to 25 m. in height, but usually smaller, with a trunk up to 60 cm. in diameter or occasionally more. The trunk is short, heavily buttressed, and branching low down or with abundant epicormics. The bark is about 1 cm. thick, soft, black, fibrous, and stringy, with a yellowish blaze. The wood is tough, white, of medium hardness, and reputedly of very poor durability. It is never cut for timber owing to its bad reputation.

"Devilwood" is an abundant tree in two of the three types of rain-forest occurring in Tobago (see Beard in Ecol. Monogr. 14: 135–163. 1944; in that paper the Tobago "devilwood" was discussed as *E. decolorans* Sandwith). It is abundant in rain-forest of the *Carapa-Andira* association and in lower montane rain-forest of the *Byrsonima-Licania* association, but it is absent from the xerophytic rain-forest of the *Manilkara-Guettarda* association, which occurs on igneous soil.

TABLE 3.

NUMERICAL OCCURRENCE OF ESCHWEILERA SANDWITHIANA IN FOREST TYPES IN TOBAGO; INDIVIDUALS PER 100 ACRES

Association	Number of trees in girth classes (girth in feet)										
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	over 10	Totals
Carapa-Andira	100	180	320	140	120	120	40	40	—	—	1060
Byrsonima-Licania	170	230	220	120	40	80	10	20	—	10	900

Eschweilera Sandwithiana ranks fourth in numbers among the dominants in both associations and forms 7% of the total number of trees over 1 ft. in girth in both cases. In the *Carapa-Andira* association its principal associates are *Carapa guianensis* Aubl., *Andira inermis* (Wright) H. B. K.,

Hieronyma caribaea Urban, *Virola surinamensis* (Rol.) Warb., *Euterpe* sp., and *Tresanthera pauciflora* (Solereder) K. Schum. In the *Byrsonima-Licania* association there are *Byrsonima spicata* (Cav.) L. C. Rich., *Licania biglandulosa* Griseb., *Ternstroemia oligostemon* Krug & Urban, *Sloanea trinitensis* Sandwith, *Euterpe* sp., and *Hirtella racemosa* Lam.

The two forest types in which the Tobago *Eschweilera* is found occur on the deep red to yellow clays developed over the schist formation. These are fairly permeable, well-drained, moisture-retentive soils with abundant root-room. The two types are differentiated by altitude, the *Carapa-Andira* association being the taller and more luxuriant, occurring at the lower levels (120–360 m.) and in more sheltered positions. The *Byrsonima-Licania* association ranges from 360 to 580 m. and is more exposed to strong winds. "Devilwood" avoids the shallow gray soil developed over the igneous formation, which lacks root-room and is physiologically dry. Rainfall of the area is probably 2500 to 3700 mm. annually, without any effective dry season.

GENERAL NOTES

Eschweilera subglandulosa is quite distinct from the other three species discussed, all of which are evidently closely related; it is a tree of the lowlands, with a hard brittle bark and heavy durable timber. This species is also known from Guiana and it has probably arrived in Trinidad since the Pleistocene by migration from that direction. The other three species are trees of montane forests; they have a soft stringy bark and timber of poor quality. One (*E. Sandwithiana*) is endemic to Tobago, another (*E.* sp.) to Trinidad, and the third (*E. trinitensis*) probably to Trinidad and the Paria Peninsula of Venezuela. These three are evidently derived from a flora of an ancient Parian land-mass which formerly united all the ranges in the system, now separated by sea. The flora of Tobago indicates continental origin, with isolation for a fairly long period. Probably all three of these *Eschweilerae* are to be considered as derivatives of a single population in the Parian flora.

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Port-of-Spain, Trinidad.

PRIORITY OF THE SPECIES PSIDIUM CATTLEIANUM SABINE

C. A. SCHROEDER

THE NAME *Psidium cattleianum* Sabine (3) has been used for many years for the species. Recently the specific name *P. littorale* Raddi was adopted by Merrill and Perry (1), who gave priority to Raddi's publication (2), based on the following evidence: "In checking the synonymy of *Psidium Cattleianum* Sabine, the name by which this species is best known, we found that *Psidium littorale* Raddi is apparently the earlier specific epithet. The fascicle in which the description and plate of the latter appears was published separately in 1820, although the date of publication is usually cited as 1823. This is the date of the title page of volume 4 complete, but when fascicle-covers are in the volume, these are to be regarded as indicating the actual date of publication rather than the title-page. We have not been so fortunate as to find any record of the publication of Sabine's name before the year 1821." Upon this evidence *P. littorale* Raddi appears as the accepted name in Standardized Plant Names (1942 edition) and thus has been circulated widely.

The priority of Raddi's description is questioned. The following facts are noted:

1. *Psidium cattleianum* Sabine occurs in Transactions of the Royal Horticultural Society 4: 316–317, *pl.*, which, according to Stearn (4), was published in May or June, 1821. The fourth volume of the Transactions has the preface-page dated April, 1822, and the cover-page dated 1823.

2. *Psidium littorale* Raddi appears in Opuscoli Scientifici (Bologna) 4 (fasc. 5): 254. The first five fascicles of the volume are dated 1820, the sixth, 1823. The whole volume is dated 1823. On pages 217–219 is included a letter dated February 8, 1821, which vitiates the 1820 publication date of the whole fifth fascicle. The unreliability of the fascicle-cover dates gives some reason for considering the publication date of fascicle 5 to be possibly as late as 1823. Furthermore, the same fascicle contains another paper (p. 276) which was presented on March 26, 1821. It seems most unlikely that the articles in fascicle 5 could have been set up in type, proofread, printed, and released within the month of April, 1821, which is the only month definitely unaccounted for in the period under consideration.

The conclusion drawn from the above evidence is that Raddi's description is not fully demonstrated to be of earlier date than Sabine's. Since *P. cattleianum* can be dated rather definitely and is probably earlier, it should be used in preference to *P. littorale*. The writer is indebted to staff-members of the Arnold Arboretum, and especially to Dr. L. Croizat, for checking the critical bibliographic references.

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3. Sabine, J. Account of a new *Psidium*. Trans. (Roy.) Hort. Soc. 4: 316–317. 1822.
4. Stearn, W. T. A supplementary catalogue of papers on the dates of publication of botanical books, p. 4. 1940 (manuscript unpublished).

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4. Stearn, W. T. A supplementary catalogue of papers on the dates of publication of botanical books, p. 4. 1940 (manuscript unpublished).

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NOTES ON SOME CULTIVATED TREES AND SHRUBS, IV

ALFRED REHDER

Salix rigida Mühlenb. f. **purpurascens** (Dieck), comb. nov.

Salix Nicholsonii f. *purpurascens* Dieck, Neuheit. Off. Zöschen, 1899–90: 18 (1889). — [Nicholson in] Kew Hand-list Trees Shrubs, 2: 223 (1896) "var."

Salix cordata var. *rigida* f. *purpurascens* Schneider, Ill. Handb. Laubh. 1: 50 (1904); in Jour. Arnold Arb. 2: 190 (1921). — Rehder, Man. Cult. Trees Shrubs, 116 (1927) "*S. c.* var. *p.*"

Salix cordata × *nigra* var. *purpurascens* Toepffer, Salicet. Exsicc. fasc. v. no. 218 (1910).

In a recent study on American Willows, Fernald has shown (Rhodora, 48: 28, 31. 1946) that *Salix cordata* Michx. is not the same as *S. cordata* Mühlenb., but is identical with the later *S. adenophylla* Hook., and that the name *S. rigida* Mühlenb. has to be taken up for *S. cordata* Mühlenb., which makes necessary the new combination proposed above. Toepffer considers this form a hybrid of *S. cordata* with *S. nigra*, but there is no indication of any influence of *S. nigra* in this form, and in a pencil note on Toepffer's specimen in the Arnold Arboretum herbarium, Schneider states: "There is no trace of *S. nigra* in it."

Amelanchier stolonifera Wieg. f. **micropetala** (Robins.), comb. nov.

Amelanchier oblongifolia var. *micropetala* Robinson in Rhodora, 10: 33 (1908). — Robinson & Fernald in Gray, Man. Bot. N. U. S., ed. 7, 460 (1908). — Weatherby in Rhodora, 18: 48 (1916). — G. N. Jones, Am. Sp. Amelanchier, 51, 52 (1946), pro syn. sub *A. spicata* (Lam.) K. Koch.

Amelanchier Botryapium var. *micropetala* Farwell in Rep. Michigan Acad. Sci. 17: 176 (1916).

Amelanchier micropetala Ashe in Bull. Torrey Bot. Club, 46: 223 (1919).

Amelanchier canadensis var. *micropetala* Rehder in Jour. Arnold Arb. 26: 71 (1945).

This *Amelanchier*, originally described as *A. oblongifolia* var. *micropetala*, seems most closely related to *A. stolonifera*, with which it agrees in its low stoloniferous habit, shape and pubescence of the leaves, the villous top of the ovary, and in the recurved sepals, but differs chiefly in its narrow small petals. From *A. oblongifolia* (Torr. & Gray) Roemer (= *A. canadensis* (L.) Med.), under which it was originally placed, it differs besides in its narrow petals, in the low stoloniferous habit, the broader leaves, the villous top of the ovary, and the recurved sepals, while *A. oblongifolia* is an upright shrub to 8 m. tall, forming dense clumps, with narrower generally oblong leaves, with the top of the ovary glabrous or nearly so, and with upright sepals. By G. N. Jones *A. oblongifolia* var. *micropetala* was referred to *A. spicata* (Lam.) K. Koch as a synonym, but this was due to a misinterpretation of Lamarck's *Crataegus spicata*, the basonym of *A. spicata* K. Koch. As Fernald has shown in a recent paper, "Amelanchier spicata not an American species" (in Rhodora, 48: 125–135.

1946). Lamarck's description of *Crataegus spicata* was based on a plant growing in the Paris Botanic Garden and also in other gardens, and supposed to have been introduced from Canada. In its main characters it agrees with the European *A. ovalis* Med., but shows the influence of an American species and is very likely a hybrid of *A. ovalis* with *A. canadensis* (L.) Med. which was at Lamarck's time already established in European gardens, having been introduced before the middle of the seventeenth century.

Pyrus Cossonii, nom. nov.

Pyrus longipes Cosson & Durieu in Bull. Soc. Bot. France, 2: 310 (1855). — Trabut in Bull. Stat. Recherch. For. N. Afr. 1: 116, *fig. 1*, *t. 4* (Poir. Indig. Afr.) (1916) "*Pirus*." — Non Poiteau & Turpin [1808].

Malus longipes Wenzig in Jahrb. Bot. Gard. Mus. Berlin, 2: 292 (1883).

Pyrus macropoda Rehder in Jour. Arnold Arb. 27: 170 (1946), non A. Savatier (1882).

In the last number of this Journal (p. 170) I proposed a new name for *Pyrus longipes* Cosson & Durieu, which was invalidated by the earlier homonym *P. longipes* Poiteau & Turpin [1808], and chose the epithet "*macropoda*" for it. Unfortunately I had overlooked the fact that for this binomial there also exists an older homonym, namely *P. macropoda* A. Savatier in Compt. Rend. Assoc. Franc. Avanc. Sci. 11 (Rochelle, 1882): 428, *fig. 87* (1883). Like *P. longipes* Poit. & Turp., the name was based on a pomological variety of *P. communis*, but since it was validly published as a binomial with a description and a figure, it cannot be rejected. Being a name without botanical significance or interest, it has apparently never been mentioned in botanical publications, and though listed in Index Kewensis, it did not appear in the main alphabetical arrangement, but in one of the supplementary additions which are easily overlooked. Among the new names proposed by A. Savatier, I also noticed a homonym which invalidates *P. rufa* Nakai (1935) and two others, namely *P. tomentosa* and *P. canescens*, which are invalidated by earlier homonyms, the former by *P. tomentosa* Moench and the latter by *P. canescens* Spach.

Rosa Harisonii Rivers var. **Vorbergii** (*R. foetida* × *spinosissima*), comb. nov.

Rosa pimpinellifolia × *lutea* Ascherson & Graebner, Syn. Mitteleur. Fl. 6, 1: 313 (1902).

Rosa Vorbergii Graebner ex Späth, [Kat.] no. 167: 71 (1915) an prius?; nom. subnud. — Mütze in Gartenschönh. 4: 102, *fig.* (1923) "*Vorbergi*"; nom. subnud. — Rehder in Man. Cult. Trees Shrubs, ed. 2, 432 (1940), pro syn.

As *Rosa Vorbergii* is a hybrid between the same species as *R. Harisonii* (*R. foetida* × *spinosissima*) it should be classed under the same binomial, but distinguished as a form or variety, since it differs markedly from the original *R. Harisonii* of 1837. It is nearer to *R. spinosissima* than typical *R. Harisonii*; the branchlets are more bristly and with less strong prickles, the sepals and the receptacle are without prickles, and the flowers are single, not double nor semi-double. In the herbarium of the Arnold Arboretum, it is represented by specimens from Spaeth's nursery, from

From *E. fruticosum* Gibbs, with which it agrees in habit and in the conspicuous straight linear cystoliths of its upper leaf-surface, *E. Greenwoodii* differs in its shorter-petiolate and much narrower leaf-blades, smaller staminate receptacles, and smaller bracteoles and stamens. In its leaf-shape, the new species more nearly resembles *E. tenellum* A. C. Sm. and *E. humile* A. C. Sm., from both of which it differs in its shrubby habit, the comparatively long straight cystoliths of its upper leaf-surface, and in details of foliage, bracteoles, and perianths.

MELIACEAE

Aglaia Parksii A. C. Sm. in Bull. Torrey Bot. Club 70: 542. 1943.

VITI LEVU: Naitasiri: Near Nasinu, *Greenwood 1136* (A) (tree 6 m. high, with rusty-pubescent inflorescence).

The cited specimen is the second collection of the species thus far known and was obtained in the vicinity of the type-locality. In vegetative features the two collections agree perfectly; the Greenwood plant has the leaflets 9 or 11 in number. The present collection bears young inflorescences, from which it is apparent that considerable variation in size of inflorescence is to be anticipated. The panicles of our plant are comparatively ample, up to 13 cm. long and 10 cm. broad, freely branched, and many-flowered. The flower-buds are too immature to permit careful observation.

STERCULIACEAE

Pterocymbium oceanicum sp. nov.

Arbor ad 22 m. alta, foliis ante anthesin deciduis, ramulis robustis glabris teretibus superne 4–5 mm. diametro, cortice in sicco pallido valde ruguloso; foliis ad apicem ramulorum confertis ubique glabris vel subtus disperse et minutissime pallido-stellato-pilosis, petiolis subteretibus 5.5–7.5 cm. longis basi et apice leviter incrassatis, laminis siccitate viridibus chartaceis ovatis, 10–15 cm. longis, 7–11 cm. latis, basi valde cordatis, apice obtusis vel obtuse cuspidatis, margine integris, e basi 7(vel inconspicue 9-)-nerviis, costa et nervis principalibus supra elevatis subtus prominentibus, nervis lateralibus e costa utrinsecus 3–5 leviter curvatis, rete venularum intricato utrinque prominulo; floribus delapsis tantum visis, pedicellis glabris teretibus supra articulationem 6–7 mm. longis; calyce tenuiter carnoso obconico-campanulato 20–25 mm. longo, apice ad 15 mm. diametro, extus glabro intus sparse et molliter pallido-piloso, lobis 5 oblongo-deltoideis acutis sub anthesi recurvatis, 8–9 mm. longis, 5–6 mm. latis; columna circiter 25 mm. longa uniformiter et breviter pilosa; staminibus 15 simplici seriei dispositis, filamentis subconnatis circiter 1.5 mm. longis extus sparse pilosis intus glabris, antheris oblongis 2–2.5 mm. longis; carpellis 5 leviter cohaerentibus copiose puberulis, ovario dorso gibboso sub anthesi circiter 1 mm. longo, stylis circiter 1.5 mm. longis superne contractis, stigmatibus pallidis reflexis circiter 0.3 mm. longis; folliculis plerumque 5 immaturis stipite copiose puberulo ad 8 mm. longo incluso ad 5 cm. longis membranaceis ubique puberulis, lobo dorsali rotundato, semine non viso.

Viti Levu: Lautoka: Mountains near Lautoka, alt. 550–600 m., *Greenwood 1082* (A, type), Sept. 24, 1944, and Aug. 18, 1945 (tree 50–75 ft. high, with wide-spreading branches; leaves clustered at ends of branchlets and light green, deciduous in August; calyx yellow-green without, red-brown within).

This remarkable discovery, which extends the known range of the genus eastward from New Guinea and the Bismarck Archipelago, was first collected by Mr. Greenwood in 1944, at which time fallen flowers and leaves were obtained. The same tree was visited in 1945 and foliage-branchlets were collected. Mature fruits are not yet available.

The new species is characterized by its entire leaves, which are clustered at the ends of branchlets, by its comparatively large calyx, which is pilose within, and by its puberulent follicles. It is perhaps more closely related to *P. viridiflorum* Teijs. & Binn., of Celebes, than to any Papuasian species, but that species is said to have glabrous follicles; other minor characters further distinguish the Fijian entity.

APOCYNACEAE

Alyxia linearifolia A. C. Sm. in Sargentia 1: 107. *fig. 5.* 1942.

Viti Levu: Lautoka: Mt. Evans, alt. about 950 m., *Greenwood 1065* (A) (shrub 3 m. high, on ridge in thick forest; flowers pale yellow).

The cited specimen is the second collection of the species, the type having been from Ra, Viti Levu, at lower elevation. The Greenwood specimen is from a shrub, whereas the type is said to have been from a liana; furthermore, the leaves of the Greenwood specimen are in twos or threes, whereas those of the type are most often in fours, although some ternate or paired leaves are discernible also on the original specimen. In spite of these differences, the two specimens are fundamentally alike, and the species is instantly recognizable.

RUBIACEAE

Amaracarpus musciferus sp. nov.

Frutex compactus multiramosus dense foliatus 1–2 m. altus, ramulis ultimis purpurascentibus teretibus gracilibus apicem versus 0.5–0.8 mm. diametro pilos pallidos pluricellulares hispidulos circiter 0.2 mm. longos copiose gerentibus, ramulis vestustioribus brunnescentibus glabratis cortice ruguloso; stipulis interpetiolaribus membranaceis purpurascentibus primo lateraliter connatis mox caducis subcalyptratis, oblongo-lanceolatis, circiter 2.5 mm. longis et 1.5 mm. latis, apice obtusis, extus ut ramulis juvenilibus sparse hispidulis; foliis glabris, petiolis minutis ad 1 mm. longis gracilibus teretibus, laminis papyraceis obovato-ellipticis, 5–7 mm. longis, 3–3.7 mm. latis, basi acutis et in petiolum minute decurrentibus, apice obtusis, margine integris et paullo incrassatis, costa supra subplana subtus elevata, nervis secundariis utrinsecus 3–5 patentibus obscuris nervo intramarginali obscure conjunctis supra immersis subtus leviter prominulis; floribus minutis ubique glabris apice ramulorum brevium ultimorum terminalibus, sessilibus, solitariis vel binis; calyce purpurascente obconico 2.5–2.8 mm. longo, tubo gracili, limbo submembranaceo erecto quam tubo paullo longiore apice circiter 1.5 mm. diametro irregulariter 4- vel 5-lobato, lobis deltoideis

vel apiculatis 0.2–0.5 mm. longis; disco conspicuo pallido pulvinato circiter 0.7 mm. alto et diametro; corolla infundibuliformi in alabastro 2.5 mm. longa, tubo immaturo 0.8–1 mm. longo, lobis 4 crasso-carnosis erectis oblongis in alabastro incurvatis circiter 1.5 × 1 mm.; staminibus 4, antheris sessilibus circiter 1 mm. longis crassis circiter 0.5 mm. diametro; stylo in alabastro circiter 1 mm. longo, stigmate minute bilobato; fructibus solitariis ovoideo-ellipsoideis 4-angulatis, ad 6.5 mm. longis (calycis limbo persistente excluso) et 4.3 mm. latis, utrinque angustatis, pyrenis ad 6 × 4 mm. semiovoideis utrinque subacutis, dorso conspicue 1-costatis, ventre plano levi.

VANUA LEVU: Mbua: Navotuvotu, summit of Mt. Seatura, alt. 830 m., *Smith 1646* (GH TYPE, NY, etc.), April 27, 1934 (gnarled shrub 1–2 m. high, in dense forest; fruit red).

In its sessile terminal flowers and fruits, as well as in its microphyllous habit, the entity described above appears definitely to belong in *Amaracarpus* Bl., which otherwise has not been recorded in Melanesia east of the Solomons. The species of *Amaracarpus* thus far known from the Solomons and from Micronesia are not closely related to the Fijian species, which shows a close affinity with certain small-leaved New Guinean species. The simple unawned stipules, the completely glabrous corolla, and the intramarginal nerve of the leaf are noteworthy characters of the Fijian plant. The specific epithet refers to the fact that the type-plant was a host to numerous bryophytes.

ARNOLD ARBORETUM,
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SOME ADDITIONAL RECORDS FOR THE GUAM FLORA

E. D. Merrill and L. M. Perry

In the process of determining some 300 numbers sent for identification by S. F. Glassman, formerly in the Navy Medical Reserve, we have found the following species apparently new for Guam. Of the genera herein recorded, 12 appear for the first time in the flora of the island, eight are introduced, and four are native.

GRAMINEAE

Oplismenus undulatifolius (Ard.) Roem. & Schult. Syst. Veg. 2: 482. 1817.

Panicum undulatifolium Ard. Animad. Spec. Alt. 14. 1764.

Guam: Mount Lamlam, *Glassman 249*, Jan. 1946, alt. about 300 m., near spring.

Tropical regions of the Eastern Hemisphere.

Pennisetum polystachyum (Linn.) Schult. Mant. 2: 146. 1824.

Panicum polystachyum (as *polystachyion*) Linn. Syst. Nat. ed. 10, 2: 870. 1759.

Guam: Outskirts of Barrigada, *Glassman 305*, Nov. 1945, along road shoulder (det. A. Chase).

Probably a native of tropical Africa and India; introduced into Polynesia. According to Mrs. Chase, this plant is an Old World annual, not to be confused with the wholly American perennial plant, *P. setosum* (Sw.) Rich.; the panicles of the latter are characterized by more numerous plumose bristles than those of the Old World species.

Andropogon fragilis R. Br. Prodr. 1: 202. 1810.

Guam: Mount Tenjo, *Glassman 270*, Jan. 1946, alt. about 240 m., open grassland.

By some workers considered as a variety of *A. brevifolius* Sw., and perhaps previously reported as this species.

Chloris inflata Link, Enum. Hort. Berol. 1: 105. 1821.

Guam: East of Barrigada, *Glassman 298*, Nov. 1945, open field.

Native of tropical America, now widespread in both hemispheres. Link's name is the oldest valid one for what was long known as *Chloris barbata* Sw.; *C. paraguayensis* Steud. is a synonym. See Hitchcock, Man. Grasses W. I. 133. 1936.

Setaria verticillata (Linn.) Beauv. Agrost. 51. 1812.

Panicum verticillatum Linn. Sp. Pl. ed. 2, 1: 82. 1762.

Guam: East of Barrigada, *Glassman 297*, Nov. 1945, open field.

Widespread weed.

COMMELINACEAE

Rhoeo discolor (L'Hérit.) Hance in Walpers, Ann. 3: 660. 1853.

Tradescantia discolor L'Hérit. Sert. Angl. 5. *t. 12*. 1788.

Guam: Alupat Island, *Glassman 230*, May 1945, along strand in sand.

Native in Mexico. Introduced in various Polynesian Islands and the Philippines.

PONTEDERIACEAE

Eichhornia crassipes (Mart. & Zucc.) Solms-Laubach in DC. Monog. Phan. 4: 527. 1883.

Pontederia crassipes Martius & Zuccarini, Nov. Gen. et Sp. Pl. Bras. 1: 9. *t. 4.* 1823.

GUAM: Northeast corner of Agaña marsh, *Glassman 121*, May 1945, in small river.

Native in the subtropics of the Americas. Introduced in the Old World tropics.

ORCHIDACEAE

Eria rostriflora Reichenb. fil. in Seem. Fl. Vit. 301. 1868.

GUAM: Vicinity of Mount Lamlam, *Glassman 234*, January 1946, epiphytic on breadfruit tree (det. C. Schweinfurth).

Society Islands (Tahiti); Fiji.

MORACEAE

Pseudomorus Brunoniana (Endl.) Bur. in Ann. Sci. Nat. V. 11: 372. 1869.

Morus Brunoniana Endl. Atakta Bot. *t. 32.* 1835.

GUAM: Oca Point, *Glassman 204*, April 1945, in woods near cliffs.

Widespread in Polynesia, Australia, and New Guinea. Previously reported from Saipan and Rota in the Marianas.

LEGUMINOSAE

Calopogonium mucunoides Desv. in Ann. Sci. Nat. I. 9: 423. 1826; Amshoff in Pulle, Fl. Suriname 2(2): 196. 1939.

GUAM: Vicinity of Piti, *Glassman 309*, Nov. 1945, open field, abundant (det. I. M. Johnston).

Native of tropical America; introduced into tropical Africa and Asia (fide Amshoff).

ICACINACEAE

Merrilliodendron rotense Kanehira, Bot. Mag. Tokyo 48: 920. *f. 7.* 1934.

GUAM: Foot of Mount Tenjo, *Glassman 240*, shrub at edge of woods.

This species has previously been reported from Rota. Sleumer, Notizbl. Bot. Gart. Berlin 15: 243. 1940, has reduced all the known material of the genus to one species, *M. megacarpum* (Hemsley) Sleumer, but until more material is available for examination, we believe the species should be held distinct. The Philippine collection may be identical with the material from San Cristoval, as far as we can tell by comparing Hooker's plate with Elmer's specimen. The leaves are oblong-elliptic and shortly acuminate. Those of the Guam collection are smaller and ovate-elliptic, acute or acuminate, the lateral nerves depart from the costa at a narrower angle, and the style is much more slender.

ELAEOCARPACEAE

Muntingia Calabura Linn. Sp. Pl. 509. 1753.

GUAM: Vicinity of Agaña, *Glassman 115, 285*, in fields.

Native in the region from Mexico to the Amazon; introduced in Siam, Java, the Philippines, and Hawaii.

PASSIFLORACEAE

Passiflora foetida Linn. var. **hispida** (DC.) Killip, Bull. Torr. Bot. Club 58: 408. 1931; A. C. Smith, Sargentia 1: 65. 1942.

GUAM: Oca Point, *Glassman 64*, open field; Soupon Point, *Glassman 105*, open field; Mount Santa Rosa, *Glassman 160*, open field.

A widespread weed, not previously reported from Guam.

LOGANIACEAE

Fagraea Sair Gilg & Benedict, Bot. Jahrb. 56: 555. *f. 3.* 1921; Kanehira, Enum. Micrones. Pl. 391. 1935.

GUAM: Vicinity of Mount Lamlam, *Glassman 233*, Jan. 1946.

Previously reported from Ponape, Kusai, and Truk.

LABIATAE

Hyptis mutabilis (A. Rich.) Briq. Bull. Herb. Boiss. 4: 788. 1896.

Nepeta mutabilis A. Rich. Act. Soc. Hist. Nat. Paris 1: 110. 1792.

GUAM: Oca Point, *Glassman 26*, Feb. 1945, jungle clearing.

Possibly *Glassman 40* also belongs here; the specimen is very immature; the calyx-lobes in the flower-bud do not appear to be quite so long as those of most collections of this species, and the inflorescence is not so open; apart from these differences the plant seems to match *H. mutabilis* (A. Rich.) Briq. very well. Like the four other species of *Hyptis* naturalized in the Old World this is a native of tropical America. Its introduction into Guam undoubtedly was through the medium of the Acapulco-Manila galleons previous to 1815.

COMPOSITAE

Emilia sonchifolia (Linn.) DC. Prodr. 6: 302. 1838.

Cacalia sonchifolia Linn. Sp. Pl. 835. 1753.

GUAM: Vicinity of Agaña, *Glassman 116, 292*, May, Nov. 1945, waste field, flowers scarlet; Mount Tenjo, *Glassman 265*, Jan. 1946, alt. about 240 m., open grassland, flowers red.

Widespread in both the Old and the New World.

Sonchus oleraceus Linn. Sp. Pl. 794. 1753.

GUAM: Foot of Mount Tenjo, *Glassman 239*, Jan. 1946, roadside.

Native in the northern part of the Old World. Apparently here recorded for the first time from Guam.

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ELMER DREW MERRILL

Dedication

To mark the seventieth birthday of Elmer Drew Merrill, Arnold Professor of Botany at Harvard, we, his associates on the editorial board of the Journal of the Arnold Arboretum, dedicate this issue to him.

It gives us much pleasure to be able to bring together for presentation to Dr. Merrill these articles written by a representative few of his botanical friends, many of whom have been closely associated with him during his years at Washington (1899–1902), Manila (1902–23), California (1924–29), New York (1930–35), and Harvard (1935–). Wherever he has served he is known for his contagious enthusiasm, for his boundless energy, and for his helpful friendliness toward all interested in botany.

Noted for his brilliance as a taxonomist, for his genius as a builder of botanical collections, and for his inspired study of the flora of the Pacific, Dr. Merrill has made a distinguished contribution to his chosen field.

October 15, 1946.